THE UNIVERSITY OF ALBERTA

DETAILS OF SOIL DISTRIBUTION IN CENTRAL STRATHCONA COUNTY, ALBERTA

by

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled "Details of Soil Distribution in Central Strathcona County, Alberta," submitted by Gopinathan Menon, B.Sc., in partial fulfilment of the requirements for the degree of Master of Science.

ABSTRACT

A detailed soil survey was carried out over 48 square miles in central Strathcona County, Alberta. The soil map was produced on a scale of 4 inches to 1 mile. The topographic phase of the soil type was chosen as the map unit. By relating the map unit to landscape features similar soil bodies could be delineated consistently. Aerial photo interpretations aided in predicting and locating soil boundaries.

Soils of the Chernozemic, Luvisolic and Solonetzic order occur widely in the area. In general, vegetation, groundwater and drainage influence profile morphology. The chernozemic and luvisolic soils represent a biosequence of soils, the former having been formed under a dominantly grassland type of vegetation, and the latter under forest. Genesis of some of the solonetzic soils is related to present day groundwater flow, and others to previous groundwater flow patterns. Some typical topographic sequences of soils in the lacustrine basin, ground moraine and the hummocky disintegration moraine are described.

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I. INTRODUCTION

This thesis presents the results of a detailed soil survey project on the distribution and characteristics of soils in a selected area in Strathcona County, Alberta.

The project area is located southeast of the city of Edmonton and Fig. 1 shows the legal location of the area. The total area is 48 square miles.

A major objective of this project was to devise and test a mapping procedure for detailed soil surveys in an area of complex soils and topography. The scope of the soil survey was multipurpose, and this was the first such soil survey carried out in Alberta. Detailed soil surveys carried out previously in Alberta were designed specifically for irrigation (Bowser *et al.*, 1963), and soil maps were produced on a scale of one inch to one mile.

For this soil survey map units were established in terms of landscape characteristics, so that they could be mapped readily and consistently. The topographic phase of the soil type was chosen as the map unit. Map unit descriptions included: (i) an account of the inclusions, and their relationship to the dominant soil in the map unit, and (ii) the relationship of the map unit to neighbouring map units.

Many of the soils in the area are formed by the Solonetzic process. Solod and Solonetz soils are common, along with the Chernozemic and Luvisolic intergrades. Chernozemic soils in the level to undulating western part of the area give way to the Luvisolic sequence

in the rolling wooded eastern half of the area. This transition represents a biosequence. Topography varies from level to rolling, and a number of topographic sequences of soils were observed.

Major kinds of soils were sampled and characterized for physical, chemical and mineralogical properties.

The survey was carried out on a scale of 1:15840. Some of the small areas separated were only about 2.4 acres. The soil map therefore, provides detailed information on the distribution and behaviour of individual kinds of soils in the area. Soils in a given map unit have a narrow range of properties particularly with regard to slope, drainage, texture, mineralogy and depth of soil.

The soil map can thus be used as a base map to develop interpretive maps with respect to capabilities and limitations of soil to support various activities. With regard to agriculture, it can be used to appraise the productive capacity of individual soils and to plan management practices accordingly. The soil map should also be especially valuable for various aspects of rural and urban planning.

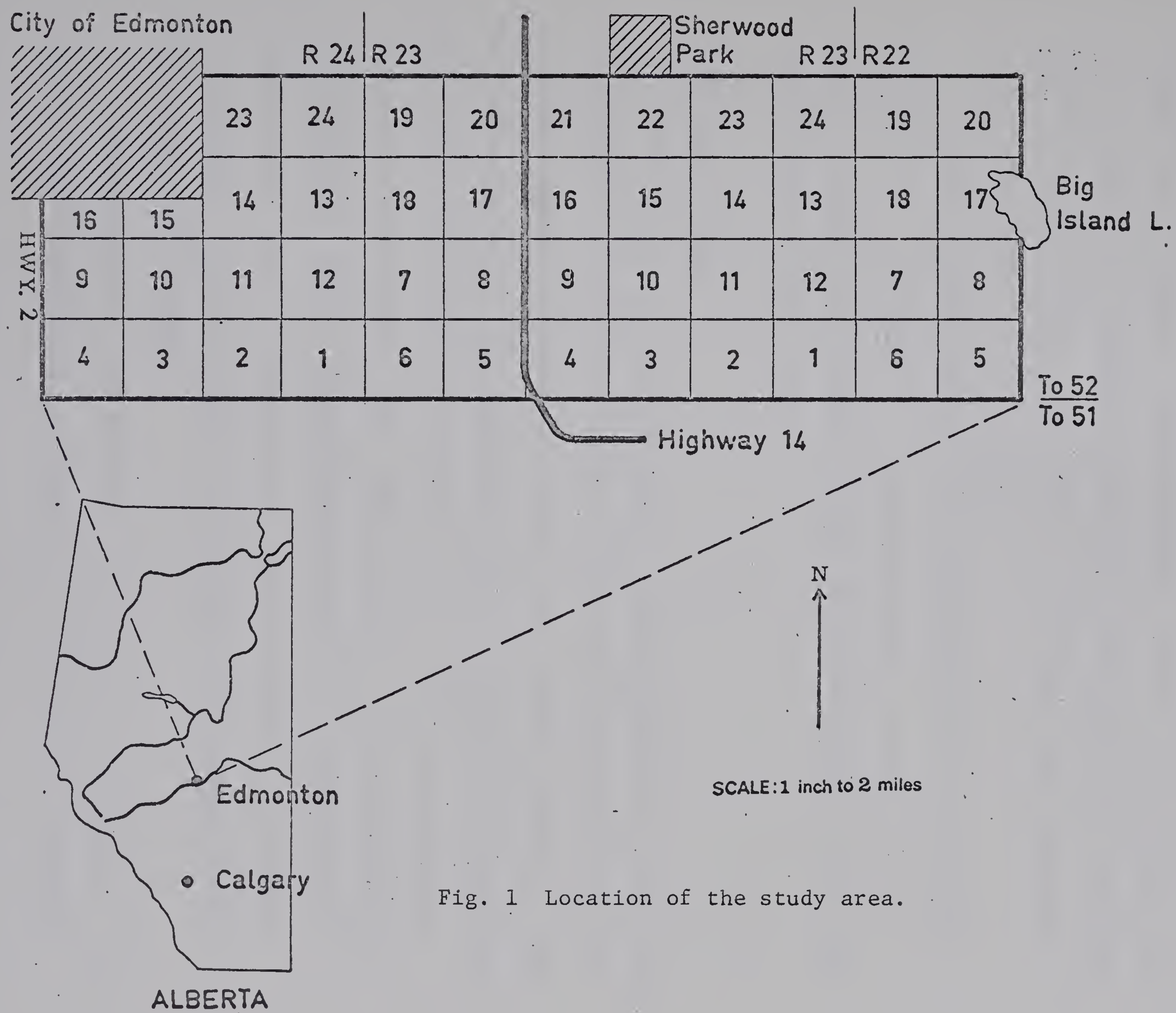

Fig. 1 Location of the study area.

II. LITERATURE REVIEW

General Statement

There is a reciprocal relationship between soil classification and soil survey (Simonson, 1968; Schelling, 1970). Map units are set up in relation to a taxonomic class, and in turn soil survey tests the validity of the taxonomic separations. Soil survey also depends on available knowledge of soil genesis.

In the following review of the literature some of the concepts with regard to soil bodies, and the relationship of mapping units to taxonomic classes are discussed. There is also an account of the scope and principles of soil survey.

The Concept of Soil

The soil is an organized natural 3-dimensional body on the surface of the earth. It has been defined as "the collection of natural bodies occupying portions of the earth's surface that supports plants and that has properties due to the integrated effect of climate and living matter acting upon parent material as conditioned by relief over periods of time" (Soil Survey Staff, 1951). This, however, is not the only meaning of the word "soil." Unconsolidated material or regolith on the surface of the earth is referred to as soil by engineers and laymen. Older geologic literature refers only to humus rich horizons as soils (Soil Survey Staff, 1960).

Soil mantles the land surface of the earth as a continuum. This continuum may be considered to consist of "a collection of organized

natural bodies that contain living matter and either have horizons or are subject to horizon differentiations" (Simonson, 1968). The concept, that soil is an independent natural body with genetic horizons, took many years to evolve. The natural body of soil has been referred to as (i) an individual (Kellogg, 1949) and (ii) polypedon (Simonson, 1962). Both these terms refer to soil bodies delineated by artificial boundaries and are aggregates of members of a taxonomic class. Different soils do not occur within the continuum as discrete entities but rather they commonly grade into each other.

To facilitate the organization of soil bodies within a natural classification system, the concept of the "smallest natural body that can be defined as a thing complete in itself - an individual" was proposed (Cline, 1949). It differed from the soil individual of Kellogg (1949) in that the latter was an aggregate of members of one class. Such a physical unit which is indivisible is necessary as a reference body for comparison and correlation between different systems of classification (Wambeke, 1966). The pedon (Simonson and Gardner, 1960) is one such individual. It is the smallest volume of soil "to include a full set of horizons and permit observations of the boundaries between them" (Simonson, 1968). The taxonomic class, soil series, consists of similar pedons. The organization of pedons within a series is based only on their degree of similarity and not on their occurrence and distribution in the landscape. Similar pedons of a soil series may be dispersed throughout an area without necessarily being contiguous.

In soil mapping, segments of the soil landscape are delineated. The process of soil correlation then relates the delineated soil bodies

to taxonomic classes in the classification system, usually at the series level. A delineated soil body consists of contiguous pedons. It is a geographic body of soil which in the soil map is represented by a delineation. Its boundaries are determined by the maximum lateral rate of change of diagnostic soil characteristics. Normally many of the pedons within a delineated soil body are similar but some inclusions of unlike pedons are invariably present. The concept of the pedon therefore is common to both the delineated soil body and a taxonomic class.

The occurrence of natural soil bodies - 'an individual that is discrete and independent of the observer' - is questioned by Knox (1965). He states that in a non-particulate continuous universe* such as the soil continuum, natural individuals do not exist. They would only exist as discrete bodies in a particulate universe. Knox believes that soils can be mapped and classified without having to define a definite volume of soil. He states that classes** may be erected within continuous universes without using individuals. Schelling (1970) points out that a classification dealing with a particular kind of universe does not necessarily apply to other universes, i.e. a classification system classifying natural particulate bodies does not classify arbitrary individuals. In this respect soil classification covering a universe of arbitrary pedons and polypedons is distinguished by Schelling from the map legend covering a universe of the particulate delineated soil bodies

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* A universe is a superclass which contains all the objects and classes under consideration (Knox, 1965).

** Classes are abstract fields, and members of classes may be either bodies or classes of lower categorical value.

of a soil map. In Schelling's terminology a map unit is a class that contains delineated soil bodies as members.

Schelling also points out the apparent confusing use of soil classification terminology, particularly the use of soil series to denote (i) a taxonomic class, (ii) a pedon, (iii) a portion of the soil landscape, and (iv) a map unit.

Although the thesis of Schelling and Knox is probably correct in principle, it seems to be a problem of semantics. Delineated soil bodies are segments of the soil landscape represented in a map. They consist of contiguous pedons, many of which, by virtue of their internal homogeneity, are similar. They can therefore be related to classes in the taxonomic system. Simonson (1968) contends that the need for a discrete soil body common to both classification and mapping is important to meaningfully relate mapped soil bodies to classes in a classification system. He states that it would be "easier for most people if they can think in terms of some physical entity rather than exclusively in terms of an abstraction." Wambeke (1966) concludes that natural bodies are not disregarded by a classification of arbitrary individuals, for "all classification at some stage from real things to mental constructions deal with sampling units which lead to other conceptual or real bodies."

Soil Survey

Variations in soil forming processes even within a small area in the field results in different soil bodies occurring on the landscape. A soil survey attempts to delineate the different soil bodies and represent them on a soil map. However, soil mapping is not the only

operation involved in a soil survey. Guy Smith (1965) defines a soil survey to include 'the examination and classification of soils in the field, location of soil boundaries in the field, plotting of soil boundaries on a map, description of the soils shown by the map including the morphology and statements about the important properties and qualities, and finally the interpretation of the map units especially for the purposes for making the soil survey.' The use of a soil survey may be multipurpose ranging from agriculture, town and country planning to civil engineering and military purposes; or it may be specifically directed to a particular application. The experience gained from one kind of soil can be applied to that kind of soil wherever it is found. This is the principal use of the soil survey, in that it allows the transfer of knowledge and experience. A soil survey therefore requires a classification from which it can derive the knowledge and experience that is applicable to the mapped area.

Kinds of soil survey. Different kinds of soil surveys are carried out depending on the purpose and conditions in the area. Smith (1965) outlines the different kinds of soil surveys as follows. An exploratory soil survey is a low intensity soil survey. Map units are generally associations of phases of great groups, and boundaries are largely inferred from a knowledge of soil forming factors, primarily climate, vegetation, geology and relief. This is the kind of survey carried out initially when a country or large area of land is being surveyed the first time. A reconnaissance soil survey is a more intensive soil survey. Observation of soils are made along traverses, and lines between traverses are made from known information. Map units

are usually phases of soil series. Boundaries between map units are observed throughout their course.

To be useful a soil survey must be constructed scientifically and have a practical purpose. This is determined largely by the mapping legend. A soil survey that is not scientifically controlled becomes useless in time when technology changes. Smith (1965) cites two examples where soil survey failed because of failure to maintain scientific standards. One was the soil survey of a wheat growing area. Ignoring soil properties, the mapping legend was set up in terms of wheat yields, so that soils with unlike properties were grouped together if yields were similar. When new and improved varieties of wheat were introduced, soils that previously were unsuitable for wheat could now support it. But yields of wheat in soils that previously produced them did not change. The survey therefore became useless because it showed only interpretation and this changes with changes in technology.

Often soil surveys have been carried out where present land use determines the range of properties within a mapping unit. Smith's second example illustrates this well. In the soil survey the map units among cultivated soils were homogenous in terms of many soil properties. The map units in low lying wet soils that were not agriculturally important were defined broadly in terms of soil texture. When it became profitable to grow vegetables in the low lying areas, it was difficult to interpret the soil maps, particularly to distinguish soils that could be easily drained from those that were impossible to drain.

Map units are separated on the basis of soil characteristics many

of which are significant to soil genesis and taxonomy. This allows for the separation of taxonomically distinct soils. Many of these characteristics also influence plant growth, engineering properties and other non-farm uses of soil. The characteristics are also readily mappable. All map units identified by a class in the taxonomic system share some fundamental property.

The delineated soil body is a small segment of the soil landscape separated from neighbouring soil bodies by a boundary. Boundary criteria are determined by maximum lateral rate of change of soil characteristics. These boundary criteria often coincide with maximum lateral rate of change of landscape characteristics. Soils generally are closely related to landforms, and many soil boundaries coincide with natural landscape boundaries. Acton (1965) found close relationship between soil member, slope gradient and slope position of various landscapes in Saskatchewan.

A map unit, for instance a phase of a soil type, while consisting dominantly of pedons within the range of that soil type may include pedons from two or more series. Inclusion up to 15 per cent may be permitted (Soil Survey Staff, 1951). However, if the inclusions do not contrast very much from the dominant soil, they may even be up to 20 per cent (Simonson, 1968). If the contrast is great, the inclusions need to be recognized and this is done by defining a complex or undifferentiated group.

In describing a mapping unit, the range of characteristics of the dominant pedons and that of the inclusions are recorded. A description of a soil pedon is only part of the map unit description, in that it is

the description of a single pedon among a group of contiguous pedons. It does not record the range of characteristics of the pedons in the map unit.

Research in soil survey. Far more research has been done in the fields of soil classification and genesis, both as separate disciplines and taken together, than in soil survey. Although soil surveys have been carried out in many countries for a long time, very little research has been published. Each soil surveyor used his knowledge and experience to carry out soil survey operations.

As Schelling (1970) points out, research in soil survey should seek out sound principles on the basis of which objective and reproducible soil surveys can be carried out. To assist in soil survey, pedogenic research should be aimed at explaining the variations in soil conditions that give rise to repeated soil patterns in the field. One such recent study in Alberta hs been the investigation into the relationships between soil and groundwater (Leskiw, 1971). Much of pedogenic research has been directed to the study of single profiles as though they were closed systems (Schelling, 1970). The soil system, however, is not a closed one. Soil bodies occur together in the landscape and are no doubt mutually related. Research should therefore investigate these relationships, and also the relationship of soil to landscape evolution.

Other recent work carried out along these lines include those by Kovda et al. (1968), Ruhe (1960), Ruhe and Walker (1968), Butler (1950), Mulcahy and Hingston (1961), Mulcahy and Humphries (1967), etc. Some work has also been done on the homogeneity and variability of map units:

Wilding et al. (1965), Powell and Springer (1965), White (1966), Protz et al. (1968), etc. But, clearly, more work is required along these lines, particularly in areas that have been mapped in detail.

Previous Work in the Project Area

Bowser et al. (1962) conducted a reconnaissance soil survey of the Edmonton sheet which included the study area. The soils mapped included Chernozems, Gray Wooded Podzols, Solonetz and Solodized Solonetz, and Gleysolic soils. Traverses were made at distances of about a mile apart. The soil map was published on a scale of one inch to two miles.

Bayrock and Hughes (1962) carried out a study of the surficial geology of the Edmonton district. Their report presents the preliminary results of the survey. The distribution of the surficial deposits is mapped on a scale of one inch to one mile.

III. METHODS

Soil Survey

There is considerable variation in many of the soil forming factors in the area surveyed. Topography ranges from level lacustrine basin to rolling dead ice moraine with ridges, knobs and kettles, sand dunes, and stream trenches. Parent material is variable and is comprised of lacustrine silts and clays, loam to clay loam till and sandy to gravelly outwash. As the area surveyed is in the parkland zone of the prairies, the natural vegetation is dominated by aspen forest and grassland. Grassland occupying the open areas is dominant in the western part of the area. Aspen forest is dominant in the eastern part. The change from grassland to aspen forest is accompanied by transition of the soils of the Chernozemic order in the west to the soils of the luvisolic order in the east. Soil distribution in the area is further complicated by the movement of saline groundwater to form Solonetz and Solodic soils throughout the area. The interaction of all these factors results in a complex soil distribution pattern.

It was felt that mapping on a scale of 4 inches = 1 mile would show good detail of the distribution of soil bodies in the area. Also, a soil map of this scale can be adapted for interpretive maps with respect to various agricultural and non-agricultural uses.

Aerial photographs on a scale of 4 inches = 1 mile (1:15840) were used as base maps, and map units were directly delineated on the photographs. Aerial photographs were favoured because: (i) they carry

good details of ground features and this allows easier orientation, and (ii) map units can generally be correlated with landscape units, they are related to physiographic features. The latter are best observed with aerial photographs.

An important aspect of soil survey operations is the construction of the mapping legend. In fact, the value of the survey is largely determined by the nature of the mapping legend. The mapping legend decides the kinds of separations to be made which in turn determines whether the practical purposes have been met while maintaining scientific standards.

To construct the initial map legend a preliminary knowledge of the kinds of soil in the area is required. The report of the soil survey of the Edmonton sheet (Bowser, et al., 1962) provided much of this information which included brief descriptions on the morphology and characteristics of the soil series present. The topographic phase of the soil type was chosen as the map unit. The soil type as a map unit meets the homogeneity demanded by the scale of mapping. Slope is also a very important property of the soil, particularly with regard to management. The use of the topographic phase also facilitates the consistent delineation of soil bodies. In general map unit boundaries could be readily predicted on the landscape. This map unit at this scale of mapping also allows a large number of predictions to be made with respect to soil use, management, capability and productivity.

To delineate the mapping units most of the area was traversed on foot. Soil boundaries were drawn in the field. A stereoscope was used to make subsequent adjustments.

Separation of the mapping units is also based on:

(i) Properties significant to soil behaviour and genesis. For example, an Orthic Black Solonetz is separated on the basis of a strongly developed, impermeable columnar Bnt underlying a black chernozemic Ah horizon. The columnar Bnt horizon is the result of solonetzic processes; its firm consistence and impermeable character render it a poor agricultural soil. High salt content that frequently is present in the C horizon will corrode pipelines and other structural equipment.

(ii) Mappable diagnostic properties. For example, the diagnostic properties of an Eluviated Black Chernozem are its thick (6") black Ap underlain by an eluviated (Ae) horizon. These features are readily observable, as is the columnar Bnt of the Black Solonetz cited above.

The mapping legend also includes mapping units such as:

(i) Soil complexes for those areas where more than one soil series are closely associated in the landscape in such a manner that they are inseparable on the scale of mapping.

(ii) Miscellaneous land types for areas altered by urban development and other unclassified soils.

Map unit descriptions include dominant pedons as well as inclusions. The range of characteristics for the area studied are noted. The pattern of distribution of the pedons, i.e. the relationship of soil bodies to the landscape and also their relationship to other mapping units is also recorded.

Sampling

Soil profiles of some major map units were sampled for physical and chemical characterization. Profile descriptions of soil were prepared and samples were collected from master horizons.

The samples were prepared for chemical and physical analysis by air drying and crushing to pass a 2 mm. sieve.

Chemical Analysis

Soil Reaction: pH was determined with a Beckman model Zeromatic pH meter in 0.01 M $CaCl_2$ solution (Peech, 1965).

Total Carbon: The total carbon was determined by a dry combustion procedure using an induction furnace as outlined by Allison et al. (1965). The CO_2 evolved was determined gasometrically with a Leco model 577-100 carbon analyser.

Total Nitrogen: This was determined by the Kjeldahl-Wilforth-Gunning method (A.O.A.C., 1955). A mixture of HgO, $CuSO_4$ and K_2SO_4 (Kelpak) was used as a catalyst.

$CaCO_3$ Equivalent: A Smolik calcimeter was used (Bascombe, 1961) to measure the $CaCO_3$ equivalent.

Exchangeable Cations and Exchange Capacity: N ammonium acetate (pH 7) was used to extract the cations (A.O.A.C., 1955). A Perkin-Elmer model 303 A.A. spectrophotometer was used to determine K^+, Na^+, Ca^{++} and Mg^{++}. The cation exchange capacity was determined by the extraction of adsorbed NH_4^+ from ethanol washed soils with 1N NaCl and distillation of the extract according to the method outlined by A.O.A.C. (1955).

Exchange Acidity: Exchange acidity was measured by leaching with 0.5 N barium acetate (pH 7). The leachate was titrated with sodium hydroxide (Brown, 1943).

Soluble Salts: The soluble cations were extracted from a saturated soil paste according to the procedure outlined in USDA Handbook 60 (1954). The saturated extract was obtained by suction. The soluble cations (Ca^+, Mg^{++}, and Na^+) were determined with the Perkin-Elmer model 303 A. A. spectrophotometer. Sulphate was determined by the turbidimetric method used in the Alberta Soil Survey Laboratory (USDA Handbook 60, 1954).

Electrical Conductivity: A direct reading Solu-Bridge model RD-26 was used to measure the electrical conductivity of the saturation extract.

Physical Analysis

Particle Size Analysis: The pipette method (Toogood and Peters, 1953) was used. Preparation of sample included removal of (i) salts by repeated washing, (ii) organic matter by hydrogen peroxide and (iii) calcium carbonate by 1 N HCL.

Soil colors were determined using the Munsell system.

Mineralogical Analysis

Clay samples were prepared for X-ray diffraction analysis according to Kittrick and Hope's (1963) procedure. Two slides of each sample were prepared. One was potassium saturated and the other magnesium saturated. The potassium saturated slide was irradiated after air drying and after heating to 550°C. using a Philips X-ray diffractometer with a high angle goniometer. The X-ray generator was operated at

40 k.v. and 20 m.a. using CuK_{α} radiation with a nickel filter. The magnesium saturated slide was similarly irradiated after air drying and after glycolation. Glycolation was done by placing the slide in a saturated atmosphere of ethylene glycol at 60°C. for 48 hours.

IV. THE ENVIRONMENT OF THE STUDY AREA

Physiography

The project area can be divided conveniently into three physiographic regions (Bayrock and Hughes, 1962): (i) Glacial Lake Edmonton area, (ii) The Ground moraine area and (iii) Hummocky disintegration moraine area.

Topography classes described in the discussion below are according to the National Soil Survey Committee (1968).

Glacial Lake Edmonton area. This is located in the western part of the project area. For the most part the topography is characteristically level to gently undulating (Plate I). The influence of prelake topography makes it difficult to define the lake area by topography alone. Near the edge pre-lake topography is reflected through the overlying

Plate 1 - View of the level to gently undulating lacustrine plain in the west. The lacustrine basin does not have a shoreline, and the ground moraine gradually merges with the lacustrine basin.

lacustrine sediments.

Glacial Lake Edmonton was an impounded lake, consequently no beach deposits were left behind, only a vast lacustrine plain. The lacustrine material thins out close to the borders.

The ground moraine area. The ground moraine area is an undulating to rolling till plain lying between the Lake Edmonton area and the hummocky disintegration moraine area. Local relief is up to about 20 feet. Knobs and kettles are common in the area. Knobs are circular hills and their size in the ground moraine area are usually between 100-300 feet in diameter and about 10 feet high. Kettles are closed depressions up to 100 feet in diameter.

Hummocky disintegration moraine. This area is found in the eastern portion of the map sheet. Topography is hilly and is made up mainly of knobs and kettles. Some prairie mounds, till ridges, stream trenches and moraine plateaus are also present.

Knobs are slightly higher in this physiographic area than in the area of the ground moraine. They have steep slopes. Some of the kettles have permanent water, and they support a variety of hydrophytic vegetation.

Prairie mounds are similar to knobs but have a central depression at the top. Till ridges as long as three quarters of a mile were observed. They are narrow, 15 to 20 feet wide and sinuous. A stream trench system a few hundred feet wide is found in the south eastern part of the area. It contains many ponds, small lakes and is filled with morainic material. Moraine plateaus are sites of former superglacial lakes and are found on small areas with level surfaces on

hilltops. They were of limited occurrence in the project area.

Drainage

Two small tributaries of the North Saskatchewan River, Mill Creek and Fulton Creek, drain the western half of the area. In the southern courses of these two creeks glaciofluvial deposits of outwash sand and some gravel are present. Numerous sloughs and many lakes are present particularly in the eastern half. Big Island Lake on the eastern boundary of the area is the biggest lake. It is almost a mile long and about half a mile wide. A major stream trench system is located in the south eastern part of the area.

Geology

Much of the area surveyed is underlain by the Edmonton formation (Bayrock and Hughes, 1962). This is an Upper Cretaceous brackish water Formation composed of interbedded bentonitic shales and sandstones with some coal seams and bentonitic bed (Westgate, 1969).

The parent material of soils, however, is derived from the surficial deposits. These include till, lacustrine material, glacial outwash and alluvial material.

The till is generally not less than 10 feet deep. Bedrock is sometimes present as erratics in the till. The texture of the till is generally a clay loam, but composition does vary from place to place due partly to the influence of the underlying bedrock. Pockets of sand and clay are often present. The till at the borders of Glacial Lake Edmonton, due to some sorting is relatively uniform.

The lacustrine material in the Lake Edmonton area is stratified

fine textured material predominantly clay and silt (Bayrock and Hughes, 1962). As a result of post glacial sorting some lake sediments are also found within the ground moraine and hummocky disintegration moraine. A few superglacial lake sediments also exist.

A more complete account of the surficial geology is available in the report of the "surficial geology of the Edmonton district, Alberta" by Bayrock and Hughes, 1962.

Vegetation

The area is in the parkland prairie phytogeographic region (Moss, 1955). Much of the natural vegetation of the area does not exist because of settlement. The parkland type vegetation is dominated by grassland and aspen (Populus tremuloides) forest occurring in 'patches as a mosaic' with grassland occupying the more arid areas, while aspen is present in the more humid parts of the landscape such as depressions and north facing slopes (Moss, 1955). The parkland also varies from open grassland with a few trees around sloughs, to areas of pure stands of aspen.

According to Moss (1955) grassland vegetation was primarily rough fescue (Festuca scabrella). In the aspen groves, aspen poplar is dominant in the well-drained areas, with balsam poplar (Populus balsamifera) occurring in the moist lowlands (Rowe, 1959). Today, the aspen poplar groves are found mainly in the hummocky disintegration moraine. Patches of willow (Salix spp.) and balsam poplar are found around sloughs and other wet spots along with other hydrophytic vegetation. Other vegetation types include the spagnum moss and labrador

tea (Ledum greelandicum) found in bogs (muskeg). These are found only in a few small areas.

Climate

The climate is continental, with warm summers and cold winters. The mean summer temperature between May to September is 56°F. July, the warmest month, averages 61.5°F. April and October average 40°F. January is the coldest month averaging 6°F. Temperature extremes rarely go above 90°F. in summer and below -40°F. in winter. The average frost-free period (above 32°F.) is about 100 days, but many vary from 50 to 150 days. A growing or vegetative season, calculated on a mean daily temperature of 42°F. is about 175 days (Bowser, et al., 1962).

The mean annual precipitation is from 16 to 18 inches, with extremes between 9 and 30 inches. Highest rainfall, just over 50 per cent, falls in the months of June, July and August. Snow constitutes about 30 per cent of the precipitation. The average annual snowfall at Edmonton is just over 50 inches. Precipitation is almost entirely snow between November and March.

There is little variation in wind velocity, which averages just under 10 miles per hour. The dominant wind direction is from the north west. An average of about 2175 hours of sunshine are received per year. This is 45 per cent of possible; during the growing season about 60 per cent of possible is received (Bowser, et al., 1962).

Present Land Use

The pattern of land use is slightly different in the eastern and western halves of the project area. This reflects the relative

suitability for agriculture in the two areas. In the western half, gentle topography and chernozemic soils are more suitable for agriculture than the rolling topography and predominantly luvisolic soils in the eastern half.

Much of the land in the western half is cultivated. About 80 per cent of the soils here are seeded to grain, particularly barley. There is also a little rape. The rest of the cultivated land is either summer fallow, pasture or hay. Some light industries are located close to the city of Edmonton.

In the eastern half between 10 to 15 per cent of the land is under forest. There is a fair amount of suburban development. Unlike the western half, pasture and hay are dominant in the cultivated areas. There is very little grain grown compared to the western half, and most of the grain is barley.

V. RESULTS AND DISCUSSION

Soil Survey

This project was designed in such a way as to provide information on soil distribution on the area in considerably more detail than was previously shown. Map units were established such that (i) they may be consistently delineated on the landscape, and (ii) possess high predictive value. The scale of the mapping would also permit interpretive maps and other land use information to be readily adapted from the soil map.

In Reconnaissance Soil Surveys carried out in Alberta, as, for example, the soil survey of the Edmonton sheet (Bowser et al, 1962), map units are generally defined broadly in terms of undesignated combinations of soil series. The scale of mapping in such surveys does not permit the separation of individual soil series. Each map unit, partly because of their broad definition and partly due to the scale of mapping, does not necessarily separate out similar portions of the landscape. Frequently, soil survey reports of such reconnaissance soil surveys do not describe (i) the relationship of the dominant soil series to others within the map unit, and (ii) the relationship of one map unit to neighbouring map units.

It is possible to carry out a detailed soil survey by the systematic examination of soils on a grid basis. It is felt that such an operation would be more time consuming than the procedure adopted. The number of profiles examined can be reduced considerably if such

examinations are made in sites suggested by predicted or probable soil boundaries. Aerial photographs are one convenient tool to use in making predictions of soil boundaries.

In the detailed soil survey carried out in this project, it was hoped that relating map units to landscape features provided a basis for an objective and reproducible soil survey. Also it is more nearly possible to delineate similar segments of the landscape on a detailed soil survey where map units are more narrowly defined.

Chemical Characteristics of the Soils

Routine chemical analyses were carried out on five widely occurring soils. These were an Orthic Black Chernozem on lacustrine, an Eluviated Black Chernozem on till; an Orthic Humic Gleysol on lacustrine, an Orthic Gray Luvisol on till and a Black Solonetz on lacustrine. The results are shown in Appendix A-I along with the profile descriptions. Extrapolation of these analyses plus existing data on similar soils provided sufficient information to allow classification of most of the soils in the map area within reasonable limits of confidence.

In general pH values of the soil increase with depth from about 5.6 near the surface to about 7.4 in the C horizon. The eluvial horizon in the Orthic Gray Luvisol and Eluviated Black Chernozem have the lowest pH values, 5.7 and 5.2 respectively, confirming that the leaching processes in the Ae horizons usually takes place under mildly acidic conditions (Kononova, 1966). The increase in pH values with depth corresponds with the increase of basic cation concentrations on the exchange complex. In the soils examined pH is highest in the C horizons of the Black Solonetz and the Orthic Humic Gleysol, 7.7 and

7.4 respectively.

Soluble salts are present in significant amounts only in the Black Solonetz and Orthic Humic Gleysols. The dominant soluble cation in the Black Solonetz, as expected, is sodium, and its concentration increases down the profile. Sodium is also the dominant soluble cation in the Orthic Humic Gleysols, but its concentrations are considerably lower than in the Black Solonetz. Sulphate is the most common anion in the Black Solonetz and is dominant in soils of Western Canada (Bowser, 1965).

The Eluviated Black and Orthic Black Chernozems have high cation exchange capacities in the Ah horizon, mainly due to the presence of large amounts of organic colloids (Buckman and Brady, 1966). Calcium and Mg^{++} are the dominant cations in the Orthic Black Chernozems, the Orthic Gray Luvisol and the Eluviated Black Chernozems. In the Black Solonetz, the exchange sites have significant Na^{+} concentrations. The ratio of exchangeable Ca^{++} to exchangeable Na^{+} in the B horizon is less than 10, and this is in accordance with the definition of the Solonetzic Order by the National Soil Survey Committee (1968). The relatively high levels of Na^{+} in the Orthic Humic Gleysol is indicative of the influence of salinity in the area.

Mineralogical Analyses of the Soils

X-ray diffraction patterns were obtained for the clay fraction of the master horizons to determine the kinds of clay present in the five pedons studied above. A semi-quantitative estimation of the relative amounts were made by peak area measurements. Results are indicated in the following order of dominance: 1-dominant; 2-major;

3-minor; 4-trace; 5-none (Appendix A-I).

All five soils were very similar in the content and relative proportions of clay minerals. Montmorillonite is the dominant clay mineral followed by minor amounts of illite. Only a trace of kaolinite and interstratified minerals are present. Clay mineralogy therefore is not a significant factor in producing differences in profile morphology. In general, soils of the great plains in Alberta have similar clay mineral content (Forman and Brydon, 1961).

Upon glycolation 16-17 A° peaks tended to be broad in the Ah horizons. Broadening of the peaks decreased down the B and C horizons. Broad peaks prevailed somewhat in the B horizons of the Orthic Humic Gleysols and the Black Solonetz.

Broadening of the peaks in the Ah is probably due to the presence of organic constituents which prevent maximum glycolation, although it is also possible that it may be due to the weathering of illite to montmorillonite (White, 1951). Organic matter is probably the cause of the broadening in the Black Solonetz and the Orthic Humic Gleysol as organic matter in the B horizons are relatively high -- 1.92 and 0.68 per cent respectively.

There is a general increase in the definition of peaks down the profile, indicating a decrease in the state of weathering of the mineral. Sharp peaks in the C horizons reflect the relative unweathered nature of the clay.

Soil Distribution Features

In general chernozemic soils are found in the western half of

the map area developed on stratified lacustrine silts and clays, and clay loam ground moraine. Some Dark Gray Chernozems are found in the western boundary of the hummocky disintegration moraine. Some also occur as 'islands' of gently undulating topography within the hummocky disintegration moraine.

Most of the solonetzic soils occur in the extreme western portion of the map area, particularly on lake sediments. Here Black Solonetz and Solonetzic Black Chernozems are dominant. In the eastern part, Gray Solonetz and Solodic Gray Luvisols are present. Solodic intergrades occur widely throughout the area.

Gleyed soils and gleysols occur in depressions throughout the area. They are rarely found over large areas. Gleysols occur most frequently as scattered pockets, or along narrow sloughs. Gleysols often occur in association with organic soils, the former usually in the relatively better drained periphery of a bog surrounding the organic soil. This kind of association is most common among the kettles in the eastern half of the map sheet.

Soil-landscape relations. Variations in slope can cause changes in soil characteristics. Such changes are often due to variation in drainage. Field observations indicate a tendency for some soils to occupy certain topographic positions on the landscape to form topographic sequences. Each of the three physiographic areas mentioned in Chapter IV appears to have its own topographic sequences.

In the lacustrine basin much of the topography is level to undulating. In the undulating topography, long gentle slopes are common. Some of the topographic sequences on these slopes are:

1) Orthic Black Chernozems or Solonetzic Black Chernozems

occupy well drained positions, and Saline Humic Gleysols occupy the poorly drained depressional areas. The intermediate or lower slope position is often occupied by Black Solonetz (Fig. 2; transect A-B).

2) The Orthic Black Chernozems are found on the well drained position. Orthic Humic Gleysols are found on the poorly drained depressions. The lower slope position is frequently occupied by Gleyed Black Chernozems (Fig. 3; transect C-D).

Saline groundwater flow and drainage apparently influence the distribution of the soil in the two topographic sequences mentioned above. Areas where Black Solonetz occur are probably sites of local groundwater discharge. This is in agreement with the findings of Pawluk, Dumanski and Toth (1969) who state that in the Edmonton area (i) Orthic Black Chernozems and Solodic Black Chernozems occur in recharge and midline areas; (ii) Black Solod and Black Solonetz occur in discharge areas, in the lower portion of the midline area or highest parts of the discharge areas, and (iii) Saline Black Solonetz occurs in a groundwater discharge area.

Groundwater discharge maintains sufficiently high levels of Na^+ in the profile for strong solonetzic features to develop. The Bn and C horizons are carbonated indicating groundwater discharge conditions (Leskiw, 1971). Saline Humic Gleysols occupy the poorly drained depression and are waterlogged most of the year. Sometimes this position is occupied by a Saline Rego Humic Gleysol. The fact that solonetzic soils are of widespread occurrence is perhaps an indication of the extent of the salinity in the area.

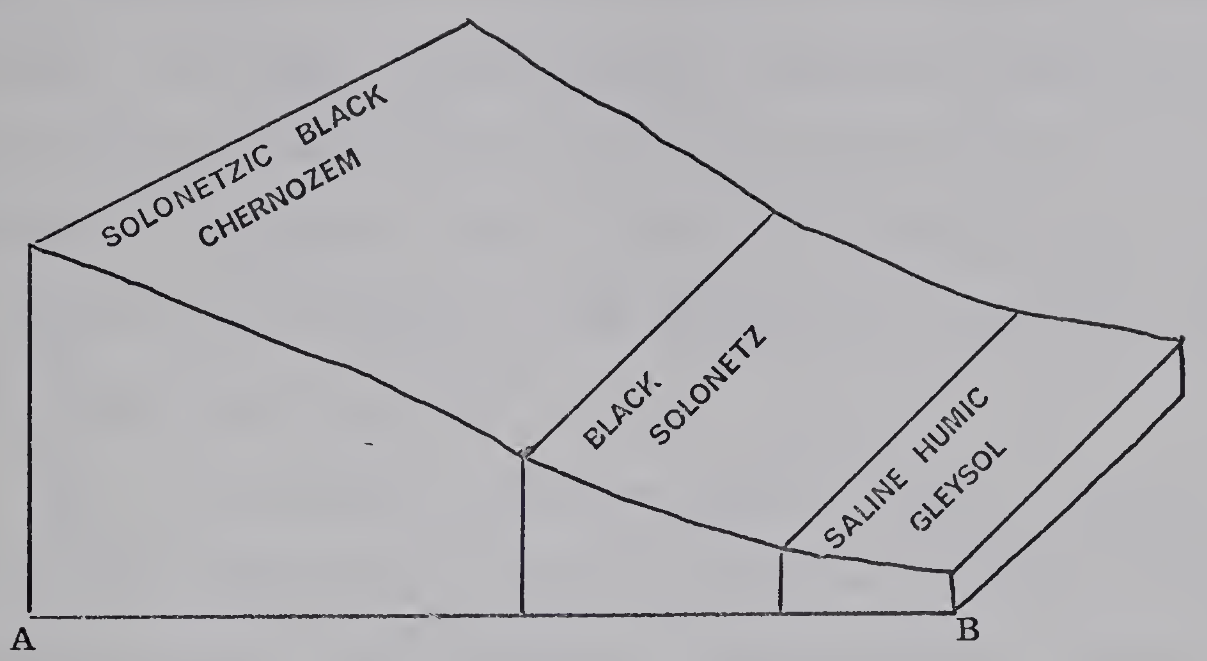

Fig. 2 A toposequence of soils in the lacustrine basin, apparently related to groundwater discharge. Small areas of Black Solonetz soils as well as Orthic Black Chernozems may be found among the Solonetzic Black Chernozems in the well drained areas. Gleyed Black Solonetz soils often occur in the landscape between the Black Solonetz and the Gleysol (see transect A-B).

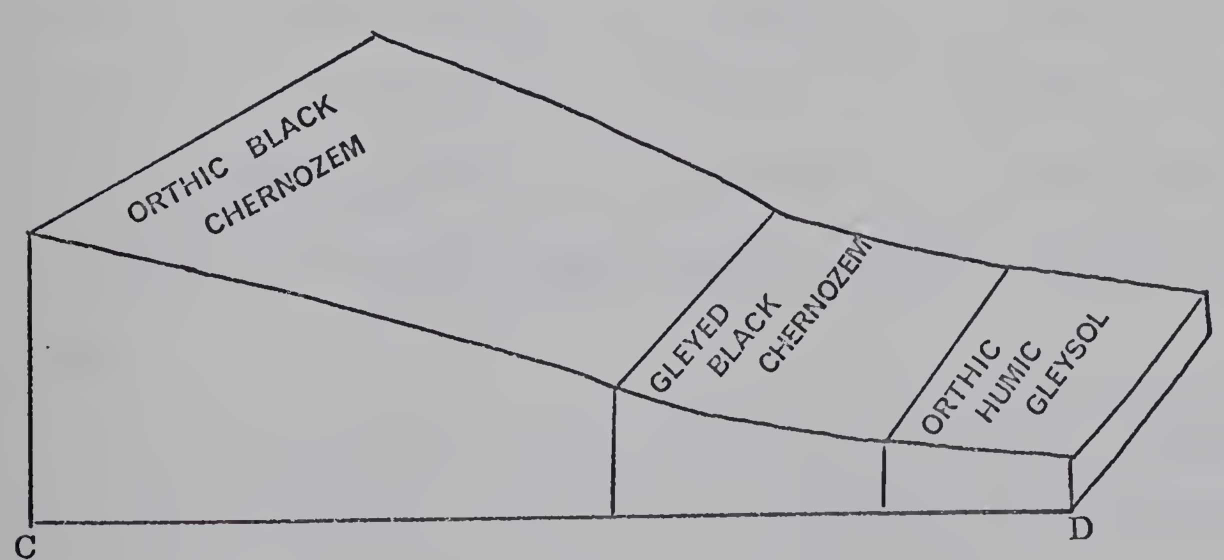

Fig. 3 This is a common toposequence of soils in the saline free areas of the lacustrine basin (see transect C-D).

The second example (Fig. 3, transect C-D) illustrates a topographic sequence of soils where pedogenesis is primarily a function of drainage. The Gleyed Black Chernozems occupy the imperfectly drained lower slope positions corresponding to the Black Solonetz of topographic sequence 1. The lower B and C horizon of the Gleyed Black Chernozem also tends to be carbonated. Some salts may be detected in the C horizon of the Orthic Humic Gleysol.

The two topographic sequences occur on similar landforms, and the Orthic Black Chernozems are found on the same elevation as the Solonetzic Black Chernozems. The difference is apparently due to local differences in the salinity of the parent material, although the parent material is genetically similar. It is also possible that the difference in some instances may be due to groundwater flow patterns being affected by the presence of interlayered materials of contrasting permeability. In some cases Black Solonetz was found on topographic highs. This anomalous occurrence of solonetzic soils on the landscape not accountable by present-day groundwater flow patterns is probably a paleo feature. Regional groundwater discharge conditions is reported to have prevailed at the time of the formation of Glacial Lake Edmonton sediments (Pawluk and Dumanski, 1969).

In the ground moraine, topography is usually undulating to rolling. The topographic sequences are slightly different from those described above.

3) Eluviated Black or Orthic Black Chernozems occupy the well drained positions. The soil may show some degree of erosion. Orthic Humic Gleysols occupy the depressional areas. Intermediate gleyed

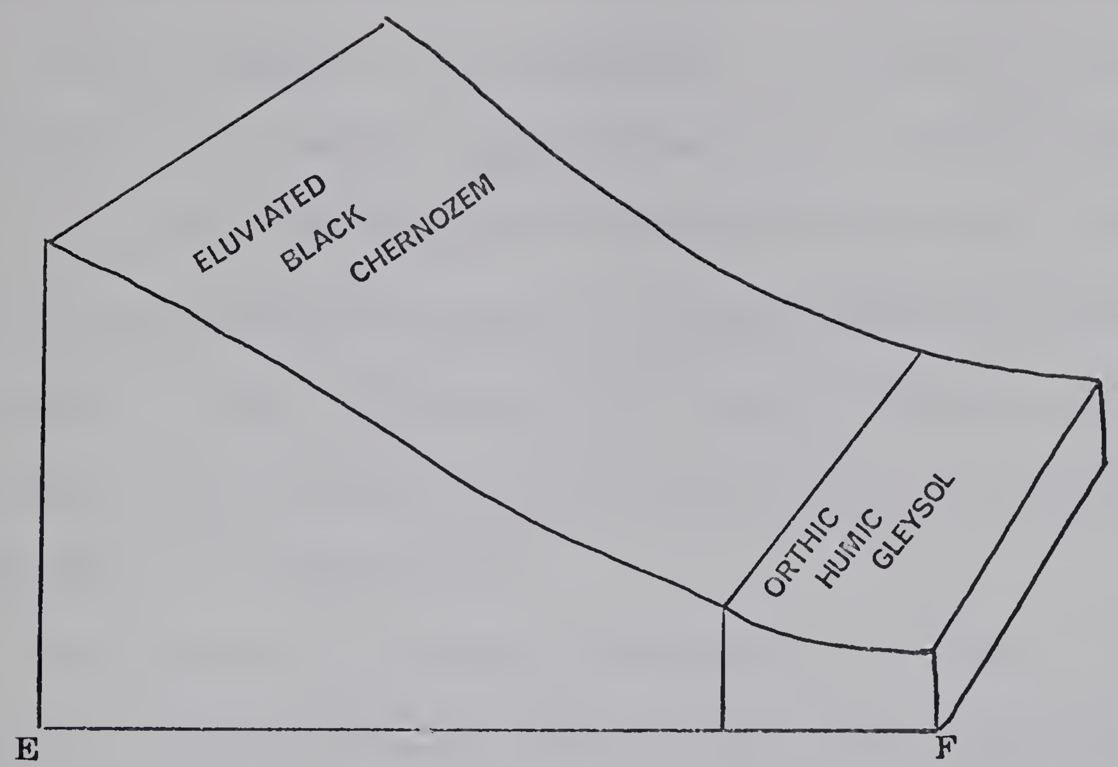

Fig. 4 A very common toposequence of soils in the ground moraine. An intermediate gleyed member if present, is usually narrow (see transect E-F).

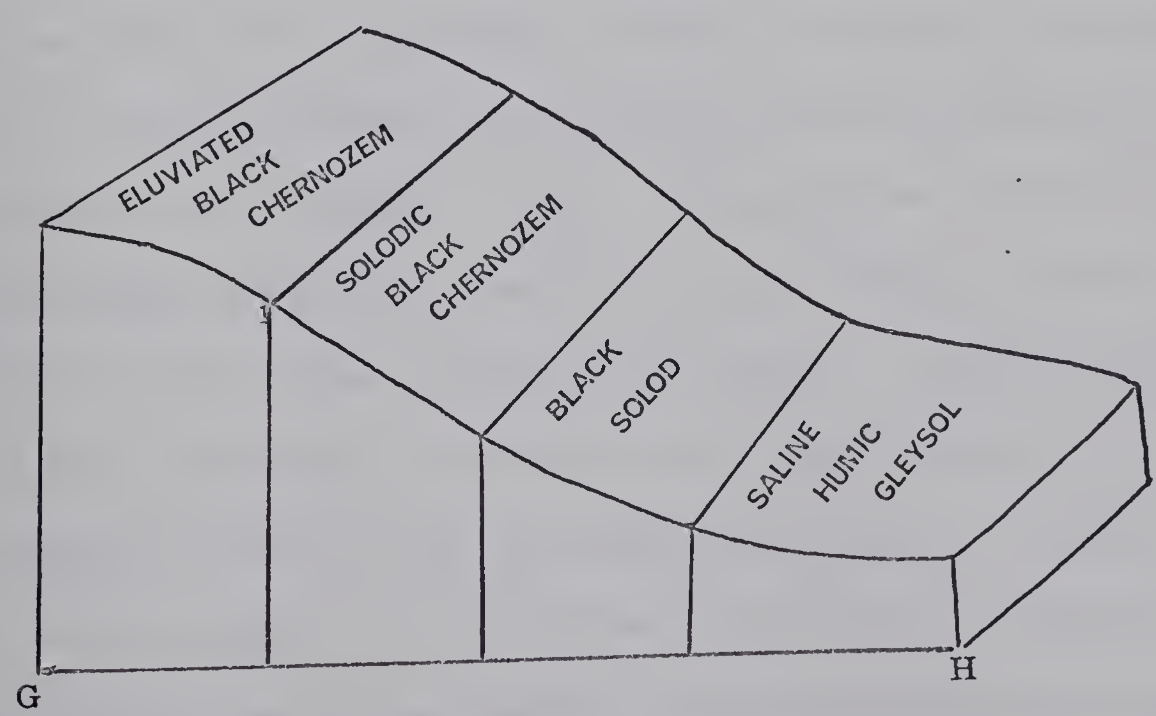

Fig. 5 A common toposequence in the solonetzic areas of the ground moraine. The sequence has evidently developed under the influence of groundwater flow (see transect G-H).

members are either narrow, or missing (Fig. 4; transect E-F).

This sequence is also dominantly a function of drainage. It is one of the most commonly occurring sequences in the ground moraine.

4) A Solodic Black Chernozem may be present in the intermediate slope. The topographic highs are occupied mainly by Eluviated Black Chernozems. Black Solonetz or Solod may be present in the lower slopes and Saline Humic Gleysols are present in the poorly drained low lying areas (Fig. 5; transect G-H).

The influence of saline groundwater is evident in this topographic sequence. Eluviated Black Chernozems and Saline Humic Gleysols are sites of groundwater recharge and discharge respectively.

Small depressional areas or sloughs are present within the topographically high well drained members. Some of these sloughs are occupied by Humic Gleysols, which are often taken to indicate recharge conditions (Leskiw, 1971).

5) In the knob and kettle topography of the hummocky disintegration moraine, the topographic sequence is usually a two member sequence. The well drained members may be Orthic Dark Gray Chernozems, Dark Gray Luvisols or Orthic Gray Luvisols. The profiles are often eroded. In the depressional areas of the kettles, Terric Humisols and more rarely peaty phases of Orthic Humic Gleysols are present. The distribution of Orthic Dark Gray Chernozems on the knobs, and Terric Humisols in the depressional areas is shown in Fig. 6; transect I-J, plate 2. Where both the Gleysol and the organic occur together, the Gleysol is generally found on the periphery of the bog surrounding the centrally placed organic soil. Sometimes at the lower slope position, Dark Gray Luvisols are found when the

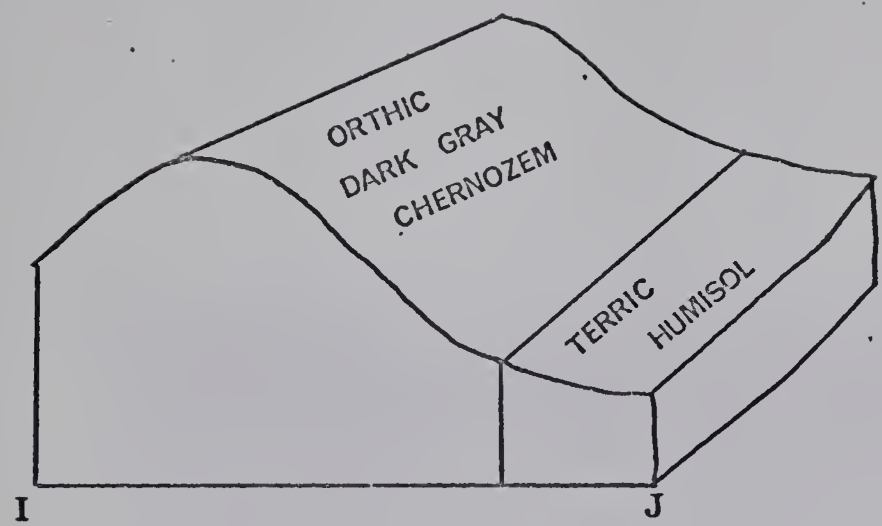

Fig. 6 A typical toposequence of soils on the knob and kettle topography of the hummocky disintegration moraine. Eroded Dark Gray Chernozems are found on the knobs and Terric Humisols in the kettles (see transect I-J and plate 2).

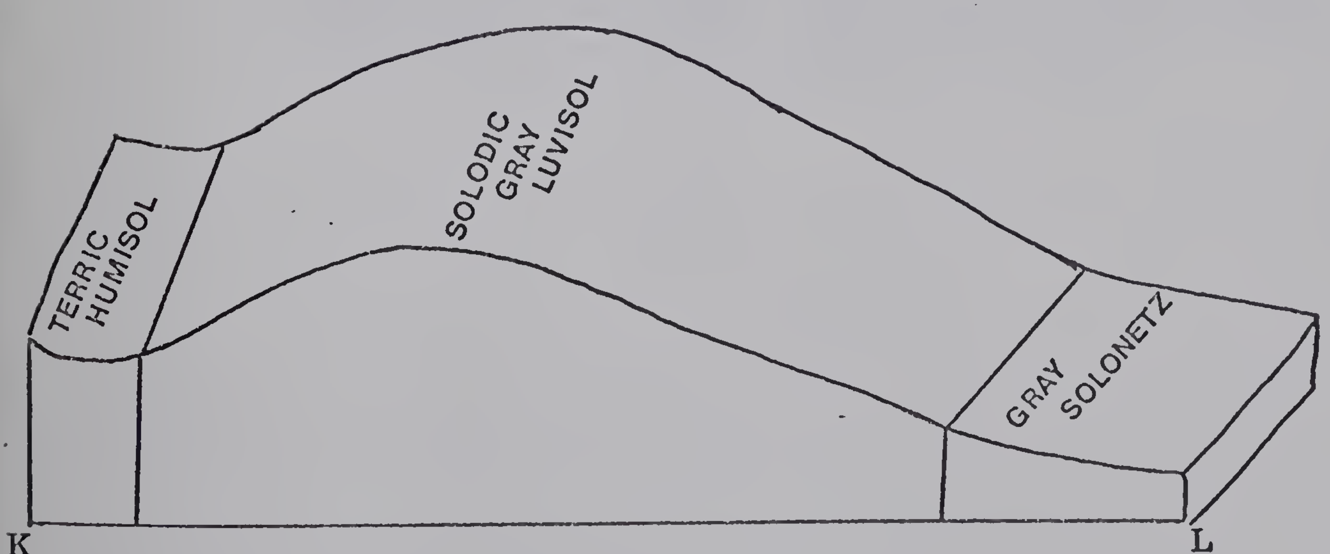

Fig. 7 This is a common toposequence in the solonetzic areas of the hummocky disintegration moraine. The low, level, moderately drained areas are occupied by Gray Solonetz, while the depressions are occupied by Terric Humisols.

Plate 2 - In the knob and kettle topography of transect I-J in the hummocky disintegration moraine, eroded Dark Gray Chernozems are found in the knobs. The organic soils shown in brown areas in the kettle are Terric Humisols.

upper member is an Orthic Gray Luvisol. They are however of limited aerial extent. Small bogs also occur on the summits of some knobs.

Solonetzic soils are limited in the hummocky disintegration moraine to the north east of the mapped area. Well drained members on topographic highs are Solodic Gray Luvisols and smaller amounts of Orthic Gray Luvisols. Saline groundwater flow affects profile morphology, and in discharge areas where a build up of salts occur, Gray Solonetz soils are found. Poorly drained depressional areas are occupied by Terric Humisols (Fig. 7; transect K-L).

Solonetzic processes. The prevalence of soils exhibiting solonetzic characteristics is an important feature of the area surveyed. The Solonetz, Solod, Solodic and Solonetzic intergrades of chernozemic and luvisolic soils are found in the project area. Solonetzic soils are particularly common in the Glacial Lake Edmonton basin.

Solonetzic soils are the result of the presence of soluble salts in the landscape. In the project area, as in the rest of Alberta, the occurrence of soluble salts on the landscape is primarily from groundwater discharge (Pawluk and Bayrock, 1969). Groundwater discharge occurred sporadically in the Glacial Lake Edmonton basin, especially during the early stage of its inception in the Holocene epoch of the Quaternary (Pawluk and Dumanski, 1969). The discharge must have been regional and widespread since many salinized areas in the present landscape cannot be explained by present day groundwater flow pattern (page 32).

Solonetz soils are found on lower slope positions and depressional areas, as well as on topographic highs (Fig. 2, 5, 7). Solonetz soils

are formed in the lower slope positions and in depressions, primarily by present day groundwater flow. Periodic groundwater discharge maintains high levels of sodium in the soil pore water and exchangeable sites on the colloidal complex. The exchangeable sodium begins to peptise the soil colloids when the salt content is less than 0.10 to 0.15 per cent (Bentley and Rost, 1947). The dispersed clays become sticky when wet and form very hard columns when dry. This is the Bnt horizon. The dispersed humates give the clay a dark color.

Most of the Solonetz soils in the study area have an Ae horizon above the Bnt, indicating that the process of solodisation has set in. Hydrolysed sodium, peptised clay and some weathering products are leached down the profile from the dispersed medium above the columnar Bnt horizon. The residual material at the top of the column becomes vesicular and has a platy structure. It has lost much of the colloidal material, and is highly siliceous and acidic. This is the Ae horizon. Weathering releases silica, which gives this horizon an ash color.

The solodisation process continues to form a Solod. Many of the Solods are found in the lower slopes and depressional areas. The topographic sequence shown in Fig. 5 illustrates the typical distribution and soil associations of Black Solods.

The thickness of the Ae increases. The Bnt horizon shows more evidence of breakdown. The monovalent sodium is lost more easily than the divalent calcium. A distinct transitional AB horizon begins to form. The Black Solod, with a profile sequence of Ah/Ae/AB/Bnt/C, is quite common in the western part of the area, particularly on till.

The Solonetz soils and Solods formed on topographic highs in the

area are apparently not related to present day groundwater flow pattern since the topographic highs appear to be positions of groundwater recharge. The parent material was probably salinized originally and the soils may well at one time have been a Saline Regosol.

Solonetzic processes are initiated by leaching of salts down the profile by natural precipitation. When the salt concentration becomes less than 0.10 to 0.15 per cent, sodium begins to peptise the colloids, and the process continues as described above.

Solodisation continues particularly in the well drained areas to form Solodic Black Chernozems. As the Ae horizon thickens, the reduction of salts renders it a more favourable medium for plant growth. Salinity ceases to be significant, and climatogenic flora begin to establish. The plant communities add organic matter and begin to circulate bases. This process eventually leads to

(i) considerable humification of the Ae, converting most of it into an Ah;

(ii) the replacement of sodium and some magnesium with calcium.

Finally the soil shows little solonetzic features in its profile morphology, although they may appear as relic features. The soil is now considered to have the characteristics of a soil developed under the existing bio-climatic conditions. The Solodic Black Chernozem has an Ah/Ae/AB/Bnjt/C profile sequence.

A logical end point of the solodisation process would be soils somewhat morphologically similar to the Eluviated Black Chernozems. The fact that Solodic Black Chernozems and Solodic Gray Luvisols occur commonly as inclusions in the Eluviated Black Chernozems and Orthic Gray

Luvisols suggests that this is probable. Also, Eluviated Black Chernozems have been observed to occur as end-members of toposequences that include Black Solods and Solodic Black Chernozems (Fig. 5). Relic features such as weakly developed columns are seen among the Eluviated Black Chernozems and Orthic Gray Luvisols, and were reported by Bowser, et al (1962).

Unlike the solodic intergrades, Solonetzic Black Chernozems are formed in a different manner. The accumulation of salts in the landscape, to begin with, was probably not large enough to produce Solonetz features. The profile sequence of a Solentzic Black Chernozemic is Ah/Bnj/C. Many of the Solonetzic Black Chernozems are found in moderate and imperfectly drained areas of the Glacial Lake Edmonton basin, and often occur with Orthic Black Chernozems. Solonetzic intergrades may also conceivably form from Saline Regosols which have been subject to a rapid flushing down of salts (Pawluk, personal communication). Such accelerated drainage could be brought about by the sudden lowering of base level in the local or regional drainage system, or even by climatic changes.

The introduction of the subgroups Solodic Black Chernozem, Solodic Gray Luvisol, Solonetzic Black Chernozem and Solonetzic Gray Luvisol into the Canadian Soil Classification System in 1968 (National Soil Survey Committee, 1968) provided for separations not made by Bowser, et al. (1962) in the soil survey of the Edmonton sheet.

In the course of this survey it was found that these soils were sufficiently distinctive morphologically to be separated and mapped. Relic or weak to moderately developed structure is discernible in the

B horizon of these intergrades. Ped surfaces still maintain some of the characteristic organic staining of Solonetz and Solods.

Biosequence. The soils of the map area show a general distribution with a chernozemic sequence in the open parkland regions to the west of the area giving way to a luvisolic sequence under the aspen groves in the eastern region. The transition zone is characterised by a thinning of the Ah horizon and a thickening of the Ae horizon as one proceeds eastwards. The Orthic Black Chernozems with about 23 cm. of Ah give way to the Orthic Dark Gray Chernozems with an Ah, Ahe (or combined Ah and Ahe) about 9 cm. thick. The Ae, if present, is usually less than 6 cm. The Ae in the Dark Gray Luvisol is greater than 6 cm., and the Ah, Ahe (or combined Ah and Ahe) is more than 6 cm. The Dark Gray Luvisols grade into the Orthic Gray Luvisols with a prominent Ae horizon and a practically non-existent Ah horizon. Plate 3 illustrates the chernozemic-luvisolic transition.

The Orthic Black Chernozems are reported to develop under a dominantly grass vegetation (C.D.A., 1970). The grass ensures an abundant supply of organic matter which supports an active population of soil micro and macroorganisms. Under these conditions, humification is the dominant pedogenetic process, and a thick well developed Ah horizon is formed. Most of the $CaCO_3$ and $MgCO_3$ in the parent material is recycled within the soil profile, and very little is lost through leaching. This results in a weakly oxidised, mellow Bm horizon. The soil has a near neutral pH.

The Luvisols are formed under a forest vegetation (C.D.A. 1970). In the project area, about 15 per cent of the luvisolic soils are still

Plate 3.1

An Eluviated Black Chernozem. The Ah is about 35 cm. thick and the Ae is about 2 cm. thick.

Plate 3.2

An Orthic Dark Gray Chernozem. The Ah is about 8 cm. thick, and the Ae about 2.5 cm. thick.

Plate 3.3

An Orthic Gray Luvisol. There is practically no Ah. Instead an L-H horizon overlies a prominent Ae horizon, which is about 12 cm. thick.

Plate 3. Road cut profiles of the biosequence of soils illustrating the chernozemic - luvisolic transition.

under forest. Pedogenetic processes in the formation of Luvisols involve the removal and transfer of inorganic and organic material (Pettapiece, 1969). The forest litter supplies the organic matter which is rapidly mineralised. Very little organic matter gets incorporated into the soil. Orthic Gray Luvisols mapped in the area have a thin leaf mat (L-H); an impoverished, light colored Ae; and an illuvial Bt horizon (Plate 3.3).

The products of the decomposition of the leaf litter are normally relatively small molecular weight organic acids (Kononova, 1966), which are important to the leaching processes. The acids are good chelating agents and move colloidal material by chelation down the profile (Fridland, 1958; Stobbe and Wright, 1959; Duchaufour, 1965).

Most of the Dark Gray Luvisols, Dark Gray Chernozems and the Eluviated Black Chernozems are developed in a narrow tension zone between the true Chernozems and the true Luvisols. An eluvial and illuvial horizon in the Eluviated Black Chernozem indicates a luvisolic process. A thick well humified Ah is developed by soils under a dominantly grass vegetation. An Eluviated Black Chernozem with an Ah and Ae horizon have at some stage of their development gone through both a chernozemic and luvisolic process. It is suggested that a well expressed Ah and Ae horizon probably indicate grassland invasion of forest (Pettapiece, 1969). It could also be the result of alternating periods during which forest or grassland communities dominated. Moss (1955) reports the tendency of aspen to invade the prairie, and the counteracting tendency of grassland invasion. The tendency for the grassland to invade is favoured by burning, grazing, prolonged periods of drought and desiccating winds (Moss, 1955). The ability of aspen to invade grassland

is largely due to vegetative regeneration. Both major climatic changes in the past and cyclical minor climatic changes of the present (Pettapiece, 1969) can initiate shifts in the forest or grassland boundaries.

Most of the Dark Gray Luvisols and Dark Gray Chernozems show strong evidence of the luvisolic process in their profile morphology. In the areas where these soils are found, forest conditions probably dominated over grassland.

An eluvial Ae horizon and an illuvial Bt could also develop from a solodisation process (page 39). Field evidence alluded to earlier does indicate that some of the Ae horizon in Eluviated Black Chernozems may have formed by solodisation.

It has been suggested that Black Chernozemic soils in the Edmonton area may have developed under meadow conditions (Pawluk, personal communication). Subsequent improvement in the drainage, and concomitant lowering of the water table could lead to the development of Black Chernozems. It is interesting to note Eluviated Chernozems and luvisolic type soils occur in the hummocky disintegration moraine, at higher elevations than the Chernozems. Westgate (1969) observed that Glacial Lake Edmonton inundated most of the Edmonton area except the hummocky disintegration moraine. The transition to the luvisolic sequence in the area surveyed is accompanied by a fairly abrupt rise in elevation between 50 to 100 feet (Plate 4). However it is not known if this feature is observable at other localities.

Detailed mapping provides evidence that hydromorphic conditions such as postulated above do in fact form chernozemic soils. Within the region of Orthic Gray Luvisols of the forested area Orthic Dark Gray

Plate 4 - Looking down from the generally higher hummocky disintegration moraine to the groundmoraine in the west. Dark Gray soils are found on the crest of the hill in the immediate foreground. Chernozemic soils are found about 200 yards down the road, after almost a 50 feet drop in elevation.

Chernozems have been mapped, as for instance in SE 12-52-23-W4. The Orthic Dark Gray Chernozem is found on level to gently undulating topography and probably developed under meadow and/or phraetophytic vegetation (balsam poplar, willow). Improved drainage may have been brought about by settlement (Pettapiece, 1969). The presence of these chernozemic soils in a region of Gray Luvisol soils indicate that hydromorphic conditions may play a significant role in the development of Chernozems in the Edmonton area.

Summary of the Soil Distribution in Area

The differentiation of profile morphology in the soils of the area is influenced principally by drainage, groundwater flow and vegetation. These three factors interact to form soils of the chernozemic, solonetzic, luvisolic and gleysolic order. Fig. 8 attempts to show the genetic interrelationship between the three major soil orders.

The transition of chernozemic soils to luvisolic soils eastwards is accompanied by a change in vegetation. Dark Gray soils are found between the chernozemic soils and luvisolic soils.

Solodic Black Chernozems and Solodic Gray Luvisols occur widely in the area. Genesis of some of the solonetzic soils is related to present day groundwater flow. Some solonetz soils are anomalous in that they do not reflect present day groundwater flow patterns. Topographic highs and lows have undoubtedly created local discharge and recharge areas. In view of the widespread occurrence of the Solodic Black Chernozems and Solodic Gray Luvisols in the project area, it is probable that most of the area was at one time extensively salinised. Remnants of isolated salinised areas are still present in topographic highs.

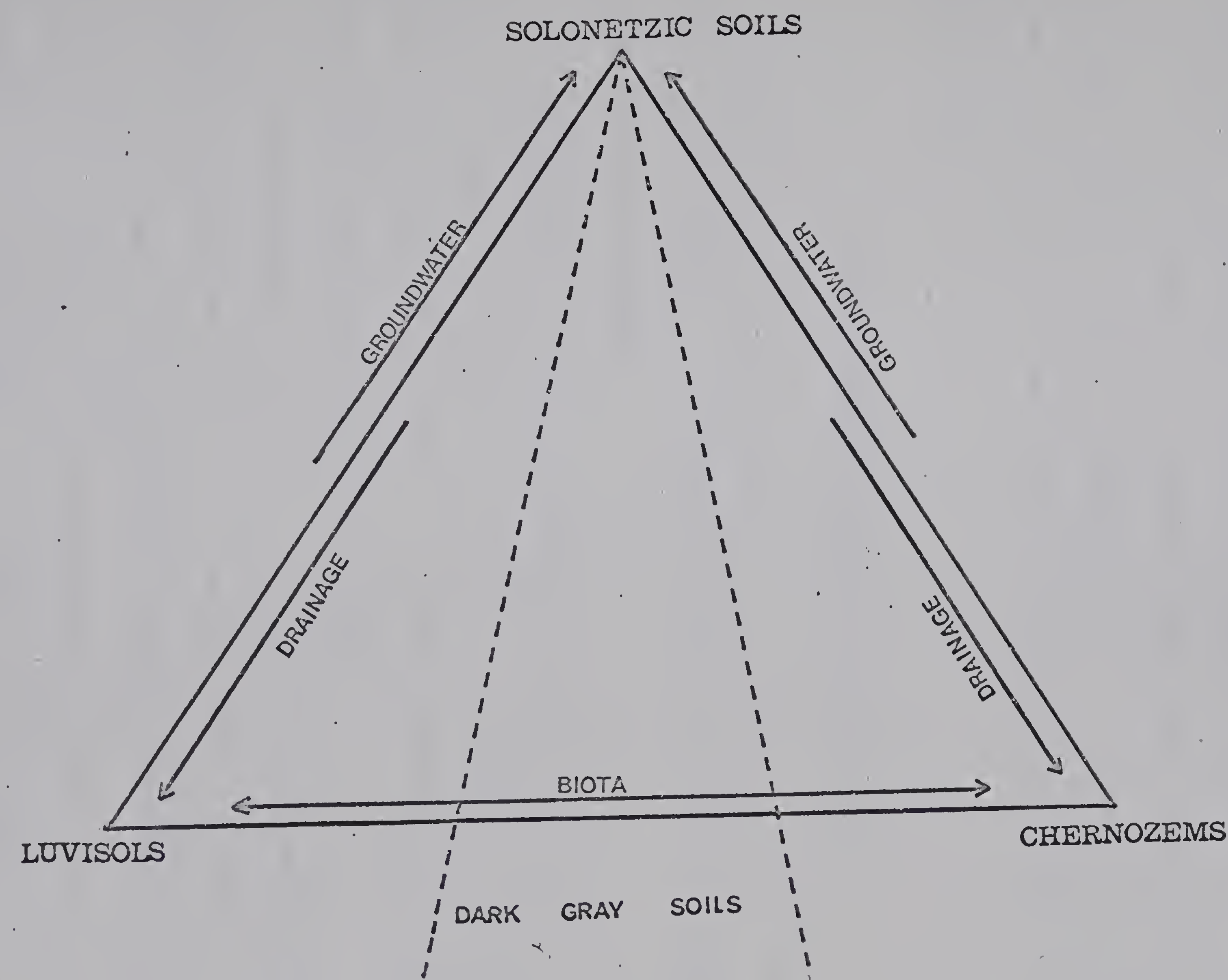

Fig. 8 A diagram indicating pedogenetic interrelationships of the three major soil orders in the study area (after S. Pawluk).

Description of the Soils

In this section map units are described. The map unit descriptions follow a general description of the soil series. The descriptions of map units only record characteristics and ranges in properties within the project area. Map unit symbols are shown in brackets.

Profile descriptions of typical pedons have been made for most of the map units and are shown in Appendix A-I. A correlation of soils described here to soil series mapped by Bowser et al (1962) is made in Appendix A-II.

Orthic Black Chernozem on Lacustrine

Soils falling in this group are found mainly in the lacustrine basin of Glacial Lake Edmonton. Topography varies from level to undulating. The soils are well drained.

The chernozemic Ap has an average thickness of about 23 cm. and a strongly developed fine granular structure. The moist colors are characteristically black (10 YR 2/1) to very dark brown (10 YR 2/2). Textures vary from silt loam to silty clay loam.

The Ap overlies a Bm horizon, typically dark grayish brown (10 YR 2/4, moist) to dark brown (10 YR 4/3, moist). The texture of the Bm is usually a clay loam, and it possesses a strong to moderate fine subangular blocky structure. The consistence is friable, and its thickness is generally more than 32 cm. It is lime free and grades to a BC or C horizon with depth. The C is often calcareous and slightly saline.

A typical pedon is described in Appendix A-I, along with chemical and mineralogical data.

Map Unit Description

Orthic Black Chernozem on lacustrine, silt loam, on 0.0-0.5% slopes (3c--a). The map unit is found mainly within the Glacial Lake Edmonton basin. Small variations in relief affect the moisture regime in these soils. In the slightly low lying areas drainage is moderate to imperfect. Gleying becomes evident, and mottles are present in the lower B and C horizons. Such areas are common in the landscape and often occupy too small an area to separate on the scale of mapping. Gleyed Black Chernozems are therefore common inclusions within the mapping unit.

Poorly drained soils in closed or open depressions are a common feature of this mapping unit. These soils display strong gleying in the B and C horizons, and are commonly Orthic Humic Gleysols.

Much of the parent material tends to be saline. In those areas where the salinity in the parent material is quite pronounced, Black Solonetz and Solonetzic Black Chernozems tend to form. These soils are therefore common inclusions. The transition from Solonetzic Black Chernozems to Orthic Black Chernozems is imperceptible. However, the B horizon of Solonetzic Black Chernozems in contrast to the B horizon of the Orthic Black Chernozem have peds that have a shiny dark organic coating on their surfaces. They also have weakly developed columnar structures and firm consistency when moist.

Black Solonetz soils can be easily distinguished from the Orthic Black Chernozems. Vegetation is usually sparse on the Black Solonetz, and often very little Ah is visible, since the Bnt horizon is cultivated. Structurally the Black Solonetz soils differ from the Orthic Black Chernozems in having well developed columns that are very firm when

moist and sticky when wet.

<u>Orthic Black Chernozem on lacustrine, silt loam, on 0.5 - 2% slopes</u> (3c-b). Most of this map unit is found on complex slopes. Some have also been mapped on simple slopes. It differs from the map unit described above in having a smaller proportion of low lying areas. Gleyed Black Chernozems and Orthic Humic Gleysols are present as inclusions in the imperfectly to poorly drained area.

Black Solonetz and Solonetzic Black Chernozems are also present as inclusions. The Black Solonetz usually occurs on the lower slope positions and slightly depressional areas. The Solonetzic Black Chernozem is found in both well drained and imperfectly drained areas.

In some areas particularly at the edge of the lake basin, lacustrine sediments overlie till at about 3 feet depth.

<u>Orthic Black Chernozem on lacustrine, silt loam, on 2 - 5% slopes</u> (3c-c). This map unit is found on both simple and complex slopes. On long slopes some gleying in the lower B horizon occurs at slope bottoms, where the gradient is more gentle. Water accumulating here from surface run off causes the gleying. The intensity of gleying at these locations is somewhat variable.

The proportions of poorly drained depressional areas is smaller than in the other two map units described above. These areas are occupied by Gleyed Black Chernozems and Orthic Humic Gleysols. Black Solonetz and Solonetzic Black Chernozems are also present as inclusions.

In some areas, particularly at the edge of the lake basin, lacustrine sediments are somewhat shallow. Till at these locations is present at a depth of about 3 feet.

Although a large percentage of the map unit is distributed within the Glacial Lake Edmonton basin, some are also found within predominantly till areas. Tills in the ground moraine area commonly have 'islands' of lacustrine sediments of varied sizes. These are sometimes sufficiently large and homogeneous enough to separate.

Black Solonetz on Lacustrine

These soils are well to imperfectly drained. They are found on level to gently undulating topography in the Glacial Lake Edmonton basin. Small areas are also found on undulating terrain, where they occupy depressional areas. Soils at these sites are gleyed within 12 inches depth.

The Ap is of variable thickness, generally ranging between 10 cm. to 25 cm. However, the Ap tends to be relatively thin compared to those of Solonetzic and Solodic Black Chernozems. In many areas the Bnt is cultivated, and this shows up within the landscape as bare patches with no vegetation. The color of the Ap is generally black (10 YR 2/1, moist) and rarely very dark brown (10 YR 2/2, moist). Texture varies from dominantly silt loam to silty clay loam.

In many cases the Ap horizon rests abruptly on the Bnt horizon. Sometimes there is an Ae horizon. Well developed columns characterize the Bnt, and these have flat or round tops. The sides of the individual columns are darkened by organic stains. Roots tend to grow between the columns. In the wet state freshly dug Bnt breaks out as massive sticky clods.

The ratio of exchangeable Ca^{++} to exchangeable Na^{+} in the Bnt is 10 or less. Textures are generally silty clay loam, clay loam or clay. Consistence is very sticky when wet, very firm when moist and extremely

hard when dry. The thickness of the Bnt horizon averages about 25 cm.

The C horizon is saline and often carbonated.

A typical pedon is described in Appendix A-I, along with chemical and mineralogical data.

Map Unit Descriptions

Black Solonetz on lacustrine, silt loam, on 0 - 0.5% slope (22c-a). This mapping unit is very common in the Glacial Lake Edmonton basin. Because of the flatness of the terrain, slight variations in topography affect the moisture regime. It is therefore common to find gleyed soils in the slightly lower areas where drainage is imperfect. Gleying is evident in the lower B and C horizons. Poorly drained depressional areas occur as small patches not large enough to separate at the scale of mapping. Soils here are usually Saline Humic Gleysols or Saline Rego Humic Gleysols.

The Bnt horizon is often cultivated, since the Ap horizon is relatively thin. In freshly cultivated fields, the map unit is characterized by the presence of hard massive clods when dry, or sticky clods when wet.

Solonetzic Black Chernozems are common inclusions. These soils are present on well drained and imperfectly drained positions. The Solonetzic Black Chernozems differ from the Black Solonetz in having weak to moderately developed columnar structure in the B horizon. The surfaces of peds however still maintain the characteristic varnish like coating. Ap tends to be thicker in the Solonetzic Black Chernozem than in the Black Solonetz.

Other map units with which this map unit is associated are Solonetzic Black Chernozems and Orthic Black Chernozems.

Black Solonetz on lacustrine, silt loam, on 0.5 - 2% slopes (22c-b). A smaller proportion of poorly drained and imperfectly drained soils are present within the map unit, than in the map unit described above. These sites are occupied by imperfectly to poorly drained soils. These soils are usually Gleyed Solonetz and Saline Humic Gleysols or Saline Rego Humic Gleysols.

Solonetzic Black Chernozems also occur as inclusions and are found on both well drained and imperfectly drained sites.

The map unit is found mainly in the Glacial Lake Edmonton basin. It is associated on the landscape with Solonetzic Black Chernozems and Orthic Black Chernozems.

Solonetzic Black Chernozem on Lacustrine

These soils are found on level to undulating terrain. Most of them are located on level topography and simple slopes within the Glacial Lake Edmonton basin. The soils are moderately well drained. Some of the important characteristics of this soil as observed in the field are discussed below.

The chernozemic Ap varies in thickness from about 10 cm. to 25 cm. Where the Ap is thin, part of the underlying Bnj horizon is ploughed, and it appears mixed with the surface Ap. The Ap horizon is friable and colors are usually black (10 YR 2/1, moist) or very dark brown (10 YR 2/2, moist). Textures are dominantly silt loam with some silty clay loam.

The texture of the underlying Bnj is usually a silty clay loam or clay loam. Columnar structure is moderate to weakly developed; nevertheless they are discernible. However, medium blocky structures are very evident. The peds show characteristic varnish like coatings on the

surface. Unlike a Solonetz or a Solod, the moist soil shows little tendency to break out as massive sticky clods when dug. The ratio of exchangeable Ca to exchangeable Na is greater than 10 in the Bnj. The C horizon may be saline.

A typical pedon is described in Appendix A-I.

Map Unit Description

Solonetzic Black Chernozem on lacustrine silt loam on 0 - 0.5% slope (3c-a). This mapping unit is normally associated with Black Solonetz soils and Orthic Black Chernozems, parts of which are common inclusions. Most of the map unit has been mapped on complex slopes.

In the field the Solonetzic Black Chernozem is often difficult to separate from the Orthic Black Chernozems. The B horizon of the Orthic Black Chernozems do not show features of the Solonetzic B horizon. Instead the structure of the B is usually strong fine subangular blocky, and the peds do not have the shiny dark organic coating.

Black Solonetz soils tend to occur in small patches. Vegetation in these areas is sparse, and the Bn is characterized by strongly developed columns. The cultivated Ap invariably includes some portions of the Bn horizon.

Poorly and imperfectly drained areas are very common within the map unit. Gleyed Black Chernozems occupy the imperfectly drained sites, and Orthic Humic Gleysols are found in the poorly drained sites. Sometimes Saline Humic Gleysols are present in the poorly drained areas and Gleyed Solonetz on the imperfectly drained sites.

Solonetzic Black Chernozem on lacustrine, silt loam, 0.5 - 2% slopes (9c-b). The map unit is found on both simple and complex topography. A good proportion of the map unit has been mapped on simple slopes. Black Solonetz and Orthic Black Chernozems occur as inclusions, the latter on well drained slopes.

On complex slopes, parts of the landscape within the map unit are poorly and imperfectly drained. Soils formed on these slopes may be Gleyed Solonetz, Gleyed Black Chernozems, Orthic Humic Gleysols or Saline Humic Gleysols.

Solonetzic Black Chernozems on lacustrine, silt loam, 2 - 5% slopes (9c-c). Most of the map unit is found on simple slopes within the Glacial Lake Edmonton basin. Some Orthic Black Chernozems and Black Solonetz soils are found as inclusions.

The Orthic Black Chernozems are found on summits and upper slope positions. The Black Solonetz is usually found on the lower slopes, but can also occur on summits and upper slope positions. On lower slope positions, surface run off accumulates to cause gleying in the lower B horizon.

Small amounts of poorly and imperfectly drained areas are found in complex topography. These sites may be occupied by Gleyed Solonetz, Saline Humic Gleysols, Gleyed Black Chernozems or Orthic Humic Gleysols.

The map unit is usually found adjacent to Black Solonetz on lacustrine and Orthic Black Chernozems on lacustrine.

Solodic Black Chernozem on Till

These soils are located mainly on undulating terrain. Like the

Solonetzic Black Chernozems, the Ap of the Solodic Black has a variable thickness ranging from 10 cm. to 25 cm. Consequently in areas where the Ap is thin, the Bnjt is often cultivated and brought up to the surface.

A characteristic feature of this soil is the AB horizon below an Ae. The AB typically has very weak prismatic structure that breaks down readily to coarse and medium platy structures. The development of the AB begins at the top of the columns of the underlying Bnjt. Thickness of the AB is usually between 9 to 12 cm.

In the Bnjt, the ratio of exchangeable Ca^{++} to exchangeable Na^{+} is greater than 10. The columnar structures are weak to moderate, and medium blocky structure is more in evidence. The ped surfaces show the varnish-like coatings of organic matter.

These soils have not been mapped extensively as a mapping unit, but occur widely as inclusions particularly in the Eluviated Black Chernozems developed on till.

A typical pedon is described in Appendix A-I.

Map Unit Descriptions

Solodic Black Chernozem on till, loam, 0.5 - 2% slopes (12a-b). The mapping unit occurs on the landscape commonly with the Eluviated Black Chernozems and Black Solods.

The Eluviated Black Chernozem is a common inclusion and is similar in profile morphology to the Solodic Black Chernozem. Unlike the Solodic Black Chernozems, however, the Eluviated Black Chernozem does not have solonetzic features in the B horizons.

Black Solods are common inclusions within the mapping unit,

when it occurs close to the Glacial Lake Edmonton basin. The Black Solod has strongly developed solonetzic features. The B horizon has strongly developed columns and a very firm consistence when moist. The consistence is hard when dry.

Small poorly drained depressional areas are common within the map unit in complex topography. Gleysols form in these areas and are commonly Orthic Humic Gleysol and Saline Humic Gleysols. Gleyed Black Chernozems may be present in imperfectly drained areas. These soils are gleyed in the lower B and C horizons.

Solodic Black Chernozems on till, loam, 2 - 5% slopes (12a-c). Eluviated Black Chernozems on till are usually associated within the map unit, and are also very common inclusions in the well drained parts of the landscape. The Black Solod is a minor inclusion. The Black Solod usually occurs on the lower slope position. A few Black Solods have been encountered on higher slopes. Inclusions of Gleysols and gleyed soils are rare.

Orthic Humic Gleysols on Lacustrine

These soils are found on poorly drained level and depressional areas. Such areas are found along the courses of streams and closed depressions.

The soil is characterized by mottling and gleying in the B horizon. The thickness of the Ah is variable. Sometimes an accumulation of peat overlies the Ah. Where the thickness of mixed peat is between 15 and 40 cm., and the thickness of fibric moss peat is between 15 to 60 cm., the soils have been mapped as peaty phases.

The B horizon is usually dark gray (10 YR 4/1, moist) or dark grayish brown (10 YR 4/2, moist).

A typical pedon is described in Appendix A-I along with chemical and mineralogical analyses.

Orthic Humic Gleysol on lacustrine, clay loam, 0 - 0.5% slopes (29b-a). The Orthic Humic Gleysol is found mainly in the western part of the project area, particularly in the Glacial Lake Edmonton region.

The Gleysol is usually associated in the landscape as a poorly drained end member in a topographic sequence with the Orthic Black Chernozems and Gleyed Black Chernozems which occupy the well-drained and imperfectly-drained position, respectively.

The C horizon of the Orthic Humic Gleysols may be saline near solonetzic areas.

Orthic Black Chernozems on Till

These chernozemic soils are found predominantly on the ground moraine. They are of considerable areal extent, and are commonly found on undulating topography. The soil is well drained.

The chernozemic Ah has an average depth of 25 cm. Moist colors are characteristically black (10 YR 2/1) to very dark brown (10 YR 2/2). The Ah has a loam texture.

The Ah is underlain by a Bm horizon that usually has a clay loam texture. Structure tends to be weakly prismatic or blocky.

The C horizon is calcareous and may be stony.

Gopher and other rodent burrows are commonly seen in these soils.

Burrows are found in the A and B horizon, and these are often filled with material brought up from the C horizon forming krotovinas. Krotovinas are also present in most of the other soils in the area.

The till from which the soils develop generally has a clay loam texture. However, wide variations are possible ranging from sandy loam to clay. Islands of sandy or lacustrine material of variable size are often incorporated within the till. Frequency of stones in the till is also quite variable. Generally, the tills closer to the Lake Edmonton basin tends to be relatively uniform and have fewer stones than tills further east.

A typical pedon is described in Appendix A-I.

Map Unit Descriptions

Orthic Black Chernozems on till, loam 0.5 - 2% slopes (4a-b). Most of the soils in this map unit occur on complex topography and are associated with Eluviated Black Chernozems.

The soil profile tends to have fewer stones in the area close to the lacustrine basin. The variability of the till is reflected in the texture of the soil. Small pockets or bands of sand provide a sandy texture to the soil and are often too small to separate on this scale of mapping. Similarly Orthic Black Chernozems developed on lacustrine are present, sometimes as inclusions when 'islands' of lacustrine material are present in the till.

In well-drained areas Solodic Black Chernozems and Eluviated Black Chernozems are common inclusions. Small areas of Cumulic Rego Black Chernozems were also observed. These are soils with a deep Ah

and a loam texture.

In complex topography small depressional areas are common. Soils here are gleyed to varying degrees and include Gleyed Black Chernozems and Orthic Humic Gleysols. In the middle of section 6-52-23-4, 30 to 40 per cent of the soils in this map unit consists of imperfectly drained soils.

Orthic Black Chernozems on till, loam, 2 - 5% slopes (4a-c). This map unit is also found mainly on complex slopes in association with Eluviated Black Chernozems.

Erosion reduces the thickness of the Ah horizon on the steeper areas of the landscape. Bands and pockets of sand and lacustrine material of variable sizes may locally influence the texture of the soil.

Solodic Black Chernozems, Eluviated Black Chernozems and some Cumulic Rego Black Chernozems are common inclusions. The Solodic Black and Eluviated Black Chernozems are found on well-drained sites. The Cumulic Rego Black Chernozem is usually found on lower slope positions. Some Orthic Humic Gleysols occur in poorly-drained areas. Very little Gleyed Black Chernozems are present as inclusions.

Eluviated Black Chernozem on Till

The Eluviated Black Chernozems are found mainly on undulating ground moraine east of the Glacial Lake Edmonton basin. The soils are well drained.

The chernozemic Ah has an average thickness of about 23 cm. Moist colors are black (10 YR 2/1). Dry colors are very dark gray (10 YR 3/1). The loam texture of the Ah is typical.

The Ah overlies an Ae horizon which has an average thickness of about 3 cm. The color of the Ae is usually light brownish gray (10 YR 6/2, dry). Texture is sandy loam or fine sandy loam, and the Ae is characterized by fine platy structures.

Below the Ae, there is often a transitional AB horizon. This is underlain by a Bt horizon. The Bt has clay loam textures and usually weak prismatic to strong blocky structure.

The C horizon is often calcareous.

A typical pedon is described in Appendix A-I, along with chemical and mineralogical analyses.

Map Unit Descriptions

Eluviated Black Chernozems on till, loam, 0.5 - 2% slopes (2a-b). The mapping unit is common in the ground moraine area. It often includes small areas of low relief where drainage is somewhat restricted. Inclusions found here are Gleyed Black Chernozems with gleying restricted to the lower B and C horizons. Orthic Humic Gleysols occur in the poorly drained areas. The B, C and the lower A horizons are gleyed in the Gleysols.

Orthic Black Chernozems on till are common inclusions. They are distinguished from the Eluviated Black Chernozems by the absence of the Ae horizon. Solodic Black Chernozems often occur as inclusions within the map unit. The Solodic Black Chernozems are quite similar morphologically to the Eluviated Black Chernozems, but the Solodic Black Chernozems have solonetzic features in the B horizon. The Bnjt of the Solodic Black Chernozems has weak to moderate columnar structure. Ped surfaces have varnish-like organic staining.

Close to solonetzic areas, the Black Solods also occur as inclusions. The Black Solod is characterized by strong columnar Bnt, the upper portion of which shows signs of breaking down (AB horizon).

This unit is usually found within large areas of the same soil occuring on steeper slopes.

<u>Eluviated Black Chernozems on till, loam, 2 - 5% slopes</u> (2a-c). The Eluviated Black Chernozems within this map unit are one of the most commonly occurring soils in the ground moraine. They are found on both complex and simple topography.

Solodic Black Chernozems and Orthic Black Chernozems occur as inclusions in well drained areas. Very little Gleyed Black Chernozems occur as inclusions, although Orthic Humic Gleysols may be present within poorly drained areas on complex topography. Near solonetzic areas in the west, Black Solods may be present. In the eastern parts of the ground moraine, Dark Gray Chernozems are present as inclusions.

<u>Eluviated Black Chernozems on till, loam, 5 - 9% slopes</u> (2a-d). These soils have been mapped mainly in the eastern parts of the ground moraine, and western parts of the hummocky disintegration moraine. Most of the soils have been mapped on simple slopes.

Small closed depressions are usually present. These are usually Terric Humisols or peaty phases of Orthic Humic Gleysols. Dark Gray Chernozems are common inclusions, increasing in proportions eastwards. Near glacial outwash deposits, Orthic Black Chernozems developed on outwash material are present as inclusions.

Parts of the surface soils are often eroded off in soils found

on the steeper positions of the landscape. Soils of this map unit occur on the landscape in association with Dark Gray Chernozems and Orthic Black Chernozems developed on till.

Orthic Dark Gray Chernozems on Till

These soils are found on undulating to rolling topography, in the western boundaries of the hummocky disintegration moraine. It is a transitional soil in the Chernozem-Luvisol sequence.

The distinguishing feature of the Orthic Dark Gray Chernozem series is that the chernozemic Ah shows signs of degradation. In virgin soils, the Ah has a value darker than 3.5 moist and 4.5 dry, and chroma usually less than 1.5. The peds of the Ahe horizon crush to gray colors between values 3.5 and 5.5 dry. The combined thickness of the Ah and Ahe is not less than 9 cm. The cultivated Ap has a thickness of at least 15 cm., and values darker than 3.5 moist and 5.5 dry. An Ae horizon, if present, is less than 6 cm.

A typical pedon is described in Appendix A-I.

Map Unit Descriptions

Orthic Dark Gray Chernozems on till, loam, 5 - 9% slopes (16a-d). The soils of this map unit occur in a north-south zone between the Luvisols in the east and Chernozems in the west. The soils are associated on the landscape with Eluviated Black Chernozem, Dark Gray Luvisols and Orthic Gray Luvisols.

Topography is gently rolling to undulating and is of the knob and kettle variety. Much of the top soil on the knobs in cultivated

fields is eroded. The Ah horizon tends to be thicker in the lower slopes.

Peaty phases of Gleysols and Terric Humisols occupy the poorly drained kettles and depressional areas. These soils are common inclusions in the map unit. Inclusions of Eluviated Black Chernozems are also common, but decrease eastwards where inclusions of Dark Gray Luvisols become dominant.

Orthic Dark Gray Chernozems on till, loam, 9 - 15% slopes (16a-e). This map unit also occurs in a north-south zone between the Chernozems in the west and the Luvisols in the east. Dark Gray Luvisols and Orthic Gray Luvisols are found associated with this map unit on the landscape.

Topography is rolling, and many knobs and kettles are present. Erosion of the top soil from the knobs is a prominent feature. The underlying B horizon is frequently exposed. Ah thickens on the lower slopes.

Peaty phases of Orthic Humic Gleysols and Terric Humisols are found in the poorly drained kettles and are frequent inclusions. Inclusions of Dark Gray Luvisols are very common.

Dark Gray Luvisols on Till

Soils of this group represent an intergrade between the Dark Gray Chernozems and the Orthic Gray Luvisols.

Under virgin conditions Dark Gray Luvisols have an organic surface horizon (L-H). The soils are characterized by a prominent Ae horizon greater than 6 cm. thick. There is an Ah, Ahe or both that is more than 5 cm. thick.

The Ah horizon shows distinct signs of degradation. In virgin soils, the Ah has a value darker than 3.5 moist and 4.5 dry, and a chroma usually less than 1.5.

An Ap horizon has a value darker than 3.5 moist and 5.5 dry.

A typical pedon is described in Appendix A-I.

Map Unit Descriptions

Dark Gray Luvisol on till, loam, 5 - 9% slope (41a-d). Like the Dark Gray Chernozems, soils of this map unit occur within a narrow north-south zone between the chernozemic soils in the west and luvisolic soils in the east.

Topography is rolling, and the soils are found on the hummocky disintegration moraine. Top soil is eroded on the knobs, exposing the Ae horizon and sometimes the Bt horizon. Some thickening of the Ah and the Ae horizons may be noticeable on the lower slopes. The Ae horizon is prominently seen on road cut profiles.

Terric Humisols and some peaty phases of Orthic Humic Gleysols are common inclusions occupying the poorly drained kettles and sloughs. Some Dark Gray Chernozems and Orthic Gray Luvisols may also be present as inclusions on well drained sites.

Dark Gray Luvisols on till, loam, 9 - 15% slopes (41a-e). The map unit is associated on the landscape with Orthic Gray Luvisols. The soils also have a north-south distribution like the soils of the map unit described above.

Topography is rolling and knobs and kettles dominate. Top soil is frequently eroded on the knobs, and the underlying Bt is often

exposed and cultivated. Some thickening of the Ah and the Ae horizons may be observed on the lower slopes.

Terric Humisols are the commonest inclusions, occupying kettles and sloughs. Orthic Gray Luvisols are present as inclusions in the well drained areas.

Orthic Gray Luvisol on Till

These are one of the most widely mapped soils, and occur extensively in the eastern half of the project area.

Under virgin conditions, the soils have an organic surface horizon (L-H), a grayish Ae horizon and a Bt horizon. An Ah or Ahe, if present, is less than 5 cm. thick, and shows distinct signs of degradation. The Ae has a dry color value of 5.5 or higher, and a chroma of less than 3.0. Often an AB horizon is present. The peds of the AB horizon usually have gray coatings on the surface.

The C horizon is calcareous.

A typical pedon is described in Appendix A-I, along with chemical and mineralogical data.

Orthic Gray Luvisol on till, loam, 5 - 9% slopes (45a-d). The map unit is found on the gently rolling knob and kettle topography of the hummocky disintegration moraine.

Many of the soils have suffered erosion. The top of the knobs are lighter colored where the Ae and sometimes the Bt is exposed. Some of the eroded material accumulates on the lower slopes and depressions. These areas appear darker colored.

Sloughs and depressions where the soils are poorly drained are common within the map unit. The soils here are usually Terric Humisols.

Small areas of level or gently undulating topography may be present within the map unit. On these areas Gleyed Dark Gray Luvisols may be present.

Orthic Dark Gray Chernozems and Dark Gray Luvisols occur as inclusions in the western areas of the map unit.

Towards the eastern part of the area, the map unit has Solodic Dark Gray Luvisols as inclusions.

Pockets or bands of sand of variable sizes occur occasionally in the till of the hummocky disintegration moraine. This influences the texture of the profile, so that small areas of sandy textured soils occur within the map unit.

The map unit is associated on the landscape with Terric Humisols. In the western areas of this mapping unit, Orthic Dark Gray Chernozems and Dark Gray Luvisols are associated with it. In the eastern areas, Solodic Gray Luvisols and to a minor extent Gray Solonetz occur along with the Orthic Gray Luvisols.

<u>Orthic Gray Luvisols on till, loam, 9 - 15% slopes</u> (45a-e). Soils of this map unit are found on rolling knobs and kettles, till ridges and banks of stream trenches.

Erosion is a prominent feature of these soils. Much of the Ap and Ae is lost through erosion. The tops of knobs and ridges are lighter colored, where the underlying Bt is exposed and cultivated. Some of the eroded material accumulates on the lower slopes and depressions. These

areas appear darker colored than the hill tops.

Many sloughs and kettles containing Terric Humisols are present within the map unit. Minor areas of imperfectly drained soils on lower slopes and in small areas of level terrain may be present. The soils at these sites are usually Gleyed Dark Gray Luvisols.

Solodic Gray Luvisols are common inclusions in well drained sites particularly in the northeastern part of the project area. Dark Gray Luvisols occur as inclusions in the central part of the project area where the Dark Gray Luvisols have been mapped.

Localised pockets or bands of sandy material in the till give rise to small areas of sandy textured soils.

The map unit is associated on the landscape predominantly with Terric Humisols and Solodic Gray Luvisols.

Solodic Gray Luvisol on Till

These soils are moderately well to imperfectly drained. They are found on rolling topography, mainly in the northeast of the project area.

The soils have a well developed Ae and AB horizon. The Bnjt has weak or relic columnar structure and moderate blocky structure. Ped surfaces show distinct staining.

The C horizon is calcareous.

A typical pedon is described in Appendix A-I.

Map Unit Descriptions

Solodic Gray Luvisol on till, loam, 5 - 9% slopes (48a-d). Most of the soils in the map unit have been mapped in the northeast part of the project area.

Gray Solonetz is a common inclusion occurring as isolated patches within the map unit. The Gray Solonetz tends to occur in slight depressions with sparse vegetation. These soils have strong columnar structure in the B; consistency is very hard when dry, and sticky when wet.

Orthic Gray Luvisols are also present as inclusions in well drained areas. Terric Humisols are found in the poorly drained sloughs and kettles.

The map unit is associated in the landscape with Orthic Gray Luvisols on rolling topography and Terric Humisols in sloughs.

Solodic Gray Luvisols on till, loam, 9 - 15% slope (48a-e). This is a widely occurring map unit. Erosion is a notable feature. On road cut exposures the organic matter staining on ped surfaces is clearly visible on freshly exposed profiles.

Orthic Gray Luvisols and Gray Solonetz are common inclusions. In the kettles and sloughs found within the map unit, Terric Humisols are present.

The map unit is associated on the landscape with Orthic Gray Luvisols on rolling topography and Terric Humisols on sloughs and depressional areas.

Rego Gleysol - Terric Humisol Complex (52)

This soil complex is found in the bottomland and the immediate vicinity of the bottomland of creeks and stream trenches. Recent alluvium makes up much of the material on which the soils are developed. Textures range from sand to clay or clay loam. The soils, generally, show little profile development. Drainage varies within very short distances, sometimes even as short as ten feet, from well drained to very poorly drained.

The soils are comprised dominantly of (i) Rego Gleysols, (ii) Peaty Rego Humic Gleysols and (iii) Terric Humisols.

In the western part of the project area, Rego Gleysols and Rego Humic Gleysols are dominant. Rego Gleysols generally occupy the central portion of the creek while the relatively better drained areas a few feet away may be occupied by Rego Humic Gleysols or Peaty Rego Humic Gleysols. Texture is commonly clay loam or clay. Bands and lenses of sand are often present in the subsoil. Some Terric Humisols may also be present. The description of a typical pedon of a Rego Humic Gleysol is given in Appendix A-I.

Terric Humisols and to a lesser extent Peaty Rego Humic Gleysols are dominant in the eastern part of the project area. The Peaty Rego Humic Gleysols usually has between 20 and 40 cm. of mixed peat on the surface. Terric Humisols have more than 40 cm. of mixed peat overlying a humic horizon. Often the humic layer of these soils have fragments of shells of fresh water molluscs.

Description of Soils of Minor Occurrence

Gleyed Black Chernozem on lacustrine, silt loam, 0 - 0.5% slopes (6c-a). These soils are present mainly as small units in the western part of the project area. They are common in level and gently undulating complex topography. A typical pedon is described in Appendix A-I.

They are often present on the landscape as an intermediate member of the toposequence with Orthic Black Chernozems in the well drained positions and Orthic Humic Gleysols in the poorly drained positions. These soils can also be associated with Black Solonetz and Solonetzic Black Chernozems, and in these situations the C and lower B horizons are often saline.

Orthic Humic Gleysols are frequent inclusions within the map unit, occurring in the more poorly drained areas. The Gleysols are often found as small, centrally located depressions within the map unit.

Orthic Black Chernozem on glacial outwash, sandy loam, 2 - 5% slopes (5d-c). Soils of this map unit are found in the southern half of the map sheet, about 4 miles east of the western boundary. The soils are rapidly drained. The thickness is usually about 15 cm. The texture of the B horizon may be sandy loam, sandy clay loam or coarse sandy clay loam. A gravelly layer may be encountered at a depth of about 75 cm. Erosion features such as rills and channels are usually seen on these soils. A typical pedon is described in Appendix A-I.

Orthic Black Chernozem on till may occur as inclusions. Small poorly drained areas are occupied by Orthic Humic Gleysols or Rego Humic Gleysols.

The map unit is associated on the landscape with Orthic Black Chernozems on till.

Solodic Black Chernozem on lacustrine, silt loam, 0.5 - 2% slopes (11c-b). Soils of this mapping unit are moderately well to imperfectly drained. Black Solonetz is a frequent inclusion. Low lying poor to imperfectly drained areas are common within the map unit. These areas are often occupied by Gleyed Solonetz or Saline Humic Gleysols. In NW9-52-24-4, Humic Eluviated Gleysols are present in the many depressional areas found within the map unit.

The map unit is associated on the landscape mainly with Black Solonetz and Solonetzic Black Chernozem.

Orthic Humic Gleysol on lacustrine, peaty phase, 0 - 0.5% slopes (32-a). These soils are found over a fairly wide area by the shores of Big Island Lake and the smaller lakes north of it, in the eastern part of the map sheet. The average thickness of the peaty surface horizon is 35 cm. In a few localities, the peaty surface exceeds 40 cm., so that Terric Humisols are common inclusions in the area.

The peat surface is very dark brown (10 YR 2/2) and the B horizon is a very dark gray (10 YR 4/1) or Black (10 YR 2/1) clay. The color of the C horizon is usually gray. Sand lenses or bands may be present in the subsoil.

Dark Gray Luvisol on glacial outwash, sandy loam, 2 - 5% slopes (42d-c). These soils are found over a small area northeast of the lake in N3-52-23-4. Till and lacustrine material occur frequently within the sola influencing the texture of the subsoil. Profile development in

some areas are weak, so that Orthic Regosols occur as inclusions. Rego Humic Gleysols are found in small poorly drained depressional areas. A typical pedon is described in Appendix A-I.

The soil is associated on the landscape with Orthic Gray Luvisols on rolling topography.

Terric Humisols, 0 - 0.5% slopes (50-a). Terric Humisols are organic soils and they are very widespread in the eastern two-thirds of the project area. They are found in the many sloughs, kettles and other depressional areas that are present in the ground moraine and hummocky disintegration moraine.

The organic surface horizon is a mixed peat whose average thickness is about 50 cm. This is usually a partly decomposed mesic layer with a color that is often reddish brown (5 YR 3/2). It is underlain by a dominantly humic horizon usually black (10 YR 2/1). Concentrations of shells of fresh water molluscs are found in some of the humic horizons. A mineral layer is usually present below 100 cm.

Common inclusions in this map unit are peaty phases of Rego Humic Gleysols and Orthic Humic Gleysols. These soils are usually found in the relatively better drained periphery of kettles and sloughs.

Terric Mesisols, 0 - 0.5% slopes (51-a). Terric Mesisols are organic soils found in bogs under stands of black spruce. The surface organic horizon is a fibric moss peat more than 50 cm. thick. This overlies a partly decomposed mesic horizon. The mineral horizon is encountered at about 100 cm. depth.

<u>Disturbed land</u> (DLD). Disturbed land is a miscellaneous land unit. Much of the natural soil profile in the map unit has been destroyed by urban development such as building sites and refuse dumps. The map unit is found mainly in the western part of the mapped area close to the city of Edmonton.

VI. SUMMARY AND CONCLUSIONS

A procedure for detailed soil mapping was tried in an area where the soil distribution pattern is complex. The scale of the soil map produced was 4 inches to 1 mile. This is the publicational scale of most soil maps used in operational planning (Kellogg, 1966). In general, the smallest areas delineated on the soil map were those large enough to enclose a symbol. Areas as small as 2.5 acres were delineated.

Map units were established in terms of landscape features. The topographic phase of the soil type was chosen as the map unit. The map unit would therefore have a narrow range of properties. The use of topographic classes in the definition of map units assisted in the consistent delineation of similar soil bodies. This map unit also enables one to predict the location of soil boundaries fairly accurately, an important attribute of this soil survey procedure.

From experience gained in this study, it is felt that an efficient way to map soils at a given scale is to use map units correlated to landscape features. Aerial photographs can then be used to assist in locating soil boundaries.

Chernozemic, luvisolic, solonetzic, gleysolic and some organic soils are found in the area. Chernozemic soils are found in the western half and luvisolic soils are found in the topographically higher eastern half. The transitional dark gray soils are found between the chernozemic and luvisolic soils. Most of the solonetzic soils occur in the Glacial Lake Edmonton basin and in the northeastern parts of the map sheet.

There is some evidence to indicate that possibly the chernozemic soils could have developed from an original hydromophic condition, and that at least some of the Ae horizons of the Eluviated Black Chernozmes are the result of Solodisation processes. Most of the soils in the area seem to have been salinised some time in the past since solodic intergrades are commonly found among these soils.

Differentiation of profile morphology is largely a function of groundwater flow, drainage and vegetation. Local groundwater flow determines the distribution of many of the solonetzic soils. Poorly drained soils are found in the lower slopes and valley bottoms. Luvisolic soils developed under forest on the hummocky disintegration moraine in the eastern part of the map sheet.

The soil map should be useful for planning various kinds of rural and urban activities. The information provided by the map should be useful in the study of some genetic relationships of soils. For instance, it is possible to list and evaluate topographic and biosequences of soil. The soil map can also be used to assist studies of groundwater flow patterns in the area.

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APPENDICES

KEY TO APPENDIX A-I

Topography and Drainage Classes: According to N.S.S.C. (1968).

Profile Descriptions: According to N.S.S.C. (1968).

Abbreviations in Table of Data:

$CaCO_3$ Equiv. (%)	Calcium carbonate equivalent
meq	Millequivalents
TEC	Total exchange capacity
EC	Electrical conductivity
S	Sand
Si	Silt
C	Clay

Clay Mineralogy: Relative proportions of clay minerals

1 - dominant:	50 per cent
2 - major:	20-50 per cent
3 - minor:	5 - 20 per cent
4 - trace:	0 - 5 per cent
5 - none	

Orthic Black Chernozem on Lacustrine

Drainage: well drained

Location: SE4-52-24-4

Horizon	Thickness	Description
Ap	23 cm.	Black (10 YR 2/1, moist) silt loam; fine granular; friable; abundant fine and very fine roots; clear, wavy boundary; 21-25 cm. thick;
Bm	32 cm.	Dark brown (10 YR 4/3, moist), dark grayish brown (10 YR 4/2, moist) silty clay loam; strong fine subangular blocky structures; friable; common fine roots; gradual wavy boundary; 30-36 cm. thick.
BC	29 cm.	Very dark gray (10 YR 3.5/2) silty clay; weak fine subangular and angular blocky structures; friable to firm; few fine roots; gradual wavy boundary; 26-35 cm. thick.
Ck	25 cm.+	Dark brown (10 YR 3/3, moist), dark grayish brown (2.5 YR 4/2, moist) clay, massive; firm to friable.

Horizon		Ah	Bm	BC	Ck
CHEMICAL ANALYSES					
pH		5.9	6.0	6.0	7.2
$CaCO_3$ Equiv. (%)		- -	- -	- -	3.32
Total Org. C (%)		5.98	1.83	1.00	1.03
Total N (%)		0.52	0.19	0.10	0.07
Exchange	H+	5.94	2.09	1.96	- --
Analysis	Ca++	34.5	21.2	22.5	- --
(meq/100g)	Mg++	7.6	8.2	9.4	- --
	Na+	0.89	0.37	0.42	- --
	K+	0.78	0.89	0.89	- --
	TEC	44.4	33.7	33.2	- --
PHYSICAL ANALYSES					
Particle	S	16	15	12	8
Size	Si	62	45	42	42
Analysis (%)	C	22	40	46	50
Texture		SiL	SiCL	SiC	C
MINERALOGICAL ANALYSES					
Mont.		1		1	1
Illite		4		4	4
Kaolinite		4		4	4
Chlorite		5		5	5

Black Solonetz on Lacustrine

Drainage: moderately well drained

Location: SW10-52-24-4

Horizon	Thickness	Description
Ap	8 cm.	Black (10 YR 2/1, moist) silty clay loam; moderate fine granular; friable; abundant fine roots; clear, wavy boundary; 6-9 cm. thick.
Bnt	25 cm.	Very dark gray (10 YR 3/1, moist) silty clay; strong coarse columnar round top macro-structure, moderate medium subangular blocky structure; very firm; few fine roots; clear, smooth boundary; 23-30 cm. thick.
Csk	24 cm. +	Dark brown (10 YR 3/3, moist) silty clay; massive; very firm.

Horizon		Ap	Bnt	Csk
CHEMICAL ANALYSIS				
pH		5.9	7.5	7.7
$CaCO_3$ Equiv. (%)		- -	0.21	1.03
Total C (%)		6.5	1.92	- -
Total N (%)		0.47	0.19	0.08
Exchange	H+	6.23	1.1	- -
Analysis	Ca++	22.0	10.7	- -
(meq/100g)	Mg++	10.2	27.6	- -
	Na+	8.7	25.0	- -
	K+	0.85	1.15	- -
	TEC	45.1	49.2	- -
PHYSICAL ANALYSES				
Particle	S	12	8	10
Size	Si	51	54	39
Analysis (%)	C	37	38	51
Texture		SiCL	SiC	SiC
MINERALOGICAL ANALYSES				
Mont.		2	1	1
Illite		3	3	4
Kaolinite		3	3	4
Chlorite		5	5	5
Soluble*	Ca++	16.3	8.2	24.3
Salts	Mg++	0.60	17.3	16.4
(meq/l)	Na+	3.82	51.2	110.3
	K+	0.07	0.05	0.16
	CO_3^-	- -	- -	- -
	HCO_3^-	1.81	7.21	1.91
	SO_4^{--}	8.3	81.2	120.
EC (mmhos/cm)*		1.5	7.8	9.2

Typical values for soluble salts and electrical conductivity of Black Solonetz soils in the lacustrine basin. These values were obrained from the Soils Division, Research Council of Alberta.

Solonetzic Black Chernozem on Lacustrine

Drainage: well drained

Location: NW4-52-24-4

Horizon	Thickness	Description
Ah	21 cm.	Black (10 YR 2/1, moist); silt loam; fine granular; very friable; abundant fine roots; clear, wavy boundary; 20-23 cm. thick.
Bnjt	23 cm.	Dark brown (10 YR 3/3, moist) with ped surfaces very dark gray (10 YR 3/1, moist); silty clay loam; moderate coarse columnar macrostructure, moderate to strong fine subangular blocky mesostructure; friable to firm; plentiful fine roots; gradual, wavy boundary; 21-25 cm. thick.
BC	16 cm.	Very dark brown (10 YR 3/2); silty clay loam; moderate fine subangular blocky; friable; few fine roots; gradual, wavy boundary; 13-17 cm. thick.
Ck	10 cm.+	Very dark grayish brown (10 YR 3/2); silty clay loam; massive.

Solodic Black Chernozem on Till

Drainage: well drained

Location: NW11-52-24-4

Horizon	Thickness	Description
Ah	16 cm.	Black (10 YR 2/1, moist); loam; fine granular; very friable; abundant fine roots; clear, wavy boundary; 15-20 cm. thick.
Ae	8 cm.	Light gray (10 YR 7/1, dry); sandy loam; moderate, medium and coarse platy; loose; abundant fine roots; clear, wavy boundary; 8 - 10 cm. thick.
AB	11 cm.	Yellowish brown (10 YR 5/4, dry); sandy clay loam; weak medium prismatic macro-structure, moderate fine subangular blocky; mesostructure; friable; clear, wavy boundary; 10-13 cm. thick.
Bnjt	30 cm.	Yellowish brown (10 YR 5/4, dry) with dark brown (10 YR 4/3, dry) ped surfaces; clay loam; moderate medium and coarse prismatic macrostructure, strong fine subangular meso-structure, friable to firm; gradual, wavy boundary; 25-37 cm. thick.
Ck	17 cm.+	Brown (10 YR 5/3, moist), yellowish brown (10 YR 5/4, moist); clay loam; massive.

Orthic Humic Gleysol on Lacustrine (slightly saline)

Drainage: poorly drained

Location: SE4-52-24-4

Horizon	Thickness	Description
Ah	20 cm.	Black (10 YR 2/1, moist),silty clay loam, weak fine granular, weak fine subangular blocky; friable; abundant fine and very fine roots; clear,smooth boundary; 17-22 cm. thick.
ABg	10 cm.	Black (10 YR 2/1, moist), silty clay; few, faint dark brown (10 YR 3/3) and dark yellowish brown (10 YR 3/4) mottles; weak fine subangular blocky; friable; plentiful fine roots; clear, wavy boundary; 8-13 cm. thick.
Bg	20 cm.	Dark gray (10 YR 4/1, moist); silty clay; prominent, distinct yellowish brown (10 YR 5/6), dark brown (7.5 YR 4/4) and yellowish red (5 YR 4/6) mottles; massive; sticky; few fine roots; clear, wavy boundary; 18-23 cm. thick.
BCg	10 cm.+	Dark gray (10 YR 4/1), silty clay; massive; very sticky.

Horizon		Ah	ABg	Bg	BCg
CHEMICAL ANALYSES					
pH		6.2	6.6	7.0	7.4
$CaCO_3$ Equiv. (%)		- -	- -	0.45	1.11
Total C (%)		9.27	5.14	0.68	1.07
Total N (%)		0.85	0.50	0.06	0.09
Exchange	H^+	4.25	1.05	- -	- -
Analysis	Ca^{++}	31.0	22.2	17.4	13.7
(meq/100g)	Mg^{++}	19.6	15.3	15.1	14.6
	Na^+	2.3	1.6	2.5	- -
	K^+	0.41	0.39	0.43	0.61
	TEC	28.5	29.2	31.1	20.7
PHYSICAL ANALYSES					
Particle	S	7	6	4	6
Size	Si	55	46	40	39
Analysis (%)	C	38	48	56	55
Texture		SiCL	SiC	SiC	SiC
MINERALOGICAL ANALYSES					
Mont.		2		2-3	1
Illite		4		4	4
Kaolinite		4		4	4
Chlorite		5		5	5
Soluble*	Ca^{++}	4.2	15.0	16.9	16.0
Salts	Mg^{++}	1.9	6.8	4.6	4.3
(meq/1)	Na^+	3.9	17.1	17.3	18.4
	K^+				
	CO_3^{--}				
	HCO_3^-				
	SO_4^{--}				
EC (mmhos/cm)*		0.8	2.8	3.2	3.3

Typical values for soluble salts and electrical conductivity of Orthic Humic Gleysols in the lacustrine basin. These values were obtained from the Soils Division, Research Council of Alberta.

Orthic Black Chernozem on Till

Drainage: well drained

Location: NW7-52-23-4

Horizon	Thickness	Description
Ah	26 cm.	Black (10 YR 2/1, moist), very dark brown (10 YR 2/2, dry); loam; strong fine granular; friable; abundant fine and very fine roots; clear, wavy boundary; 25-33 cm. thick.
AB	22	Yellowish brown (10 YR 5/4, dry); clay loam; weak prismatic and coarse blocky; friable; plentiful,fine roots; clear,wavy boundary; 20-25 cm. thick.
Bm	25 cm.	Dark brown (10 YR 4/3, dry); clay loam; weak prismatic and blocky; friable to firm; few fine roots; gradual,wavy boundary; 23-30 cm. thick.
Ck	10 cm.+	Dark gray brown (10 YR 2/4, dry); clay loam; massive.

Eluviated Black Chernozem on Till

Drainage: well drained

Location: SE17-52-23-4

Horizon	Thickness	Description
Ah	35 cm.	Very dary gray (10 YR 3/1, dry), black (10 YR 2/1, moist); loam; strong fine granular; friable; abundant fine and very fine roots; clear, wavy boundary; 30-40 cm. thick.
Ae	3 cm.	Light gray (10 YR 7/2, dry); loam; moderate fine platy; friable; plentiful fine roots; clear, wavy boundary; 2-4 cm. thick.
AB	7 cm.	Light yellowish brown (10 YR 6/4, dry); clay loam; strong fine subangular blocky and weak medium angular blocky; slightly hard; few fine roots; gradual, wavy boundary; 4-9 cm. thick.
Bt1	17 cm.	Yellowish brown (10 YR 5/4, dry); clay loam; strong fine subangular blocky and strong medium angular blocky; hard; very few fine roots; gradual,wavy boundary; 14-20 cm. thick.
Bt2	22 cm.	Dark brown (10 YR 4/3, dry); clay loam; moderate medium prisms; hard; very few fine roots; gradual,wavy boundary; 20-24 cm. thick.
Ck	16 cm.+	Yellowish brown (10 YR 5/4, moist); clay loam; massive; hard.

Horizon		Ah	Ae	AB	Bt1	Bt2	Ck
CHEMICAL ANALYSES							
pH		5.4	5.2	4.9	5.1	5.1	7.1
$CaCO_3$ Equiv. (%)		- -	- -	- -	- -	- -	2.35
Total C (%)		3.98	0.66	0.70	0.37	0.55	- -
Total N (%)		0.35	0.08	0.06	0.05	0.05	- -
Exchange	H^+	6.21	1.88	3.28	2.30	1.82	- -
Analysis	Ca^{++}	20.0	9.0	11.7	11.0	12.0	- -
(meq/100g)	Mg^{++}	4.7	3.7	5.0	5.1	4.7	- -
	Na^+	- -	0.2	0.1	0.1	0.2	- -
	K^+	0.6	0.4	0.5	0.5	0.5	- -
	TEC	28.6	14.2	18.4	18.9	17.0	- -
PHYSICAL ANALYSES							
Particle	S	31	39	40	34	34	39
Size	Si	44	42	32	32	28	30
Analysis (%)	C	25	19	28	32	28	31
Texture		L	L	CL	CL	CL	CL
MINERALOGICAL ANALYSES							
Mont.		2	1		1		1
Illite		4	4		4		4
Kaolinite		4	4		4		4
Chlorite		5	5		5		5

Orthic Dark Gray Chernozem on Till

Drainage: well drained

Location: SE4-52-23-4

Horizon	Thickness	Description
L-H	2.5 cm.	Loose leaf litter.
Ah	10 cm.	Very dark grayish brown (10 YR 3/2, dry) loam; fine granular; friable; abundant fine roots; clear, wavy boundary; 9-12 cm. thick.
Ahe	2.5 cm.	Very pale brown (10 YR 7/4, dry); loam; granular to weak platy; friable; abundant fine roots; clear,wavy boundary; 2-2.5 cm. thick.
AB	11 cm.	Yellowish brown (10 YR 5/6, dry); sandy clay loam; moderate medium subangular blocky; hard; few fine roots; gradual, wavy boundary; 7-13 cm. thick.
Bt	43 cm.	Yellowish brown (10 YR 5/6, dry); clay loam; weak prismatic macrostructure; strong fine angular blocky mesostructure; hard; very few fine roots; gradual,wavy boundary; 39-48 cm. thick.
BC	18 cm.	Yellowish brown (10 YR 5/4, dry); clay loam; weak prismatic to moderate medium subangular blocky; firm; gradual,wavy boundary; 14-19 cm. thick.
Ck	10 cm.+	Yellowish brown (10 Yr 5/4, dry); dark yellowish brown (10 YR 4/4, dry); clay loam; massive to weak subangular blocky; hard.

Dark Gray Luvisols on Till

Drainage: well drained

Location: SW10-52-23-4

Horizon	Thickness	Description
L-H	2.5 cm.	Loose leaf litter.
Ah	5 cm.	Dark gray (10 YR 4/1, dry), very dark grayish brown (10 YR 3/2, dry); loam; weak fine subangular blocky; friable; abundant fine roots; clear, wavy boundary; 4-6 cm. thick.
Ahe	4 cm.	Grayish brown (10 YR 5/2, dry); sandy loam to loam; weak platy; loose to friable; abundant fine roots; clear, wavy boundary; 2-5 cm. thick.
Ae	8 cm.	light gray (10 YR 7/2, dry); sandy loam; fine platy; loose; abundant fine roots; clear,wavy boundary; 7-10 cm. thick.
Bt	42 cm.	Brownish yellow (10 YR 6/5, dry), brown (10 YR 5/3, dry); clay loam; weak prismatic macrostructure, moderate medium subangular blocky mesostructure; hard; few fine roots; gradual,wavy boundary; 38-53 cm. thick.
Ck	20 cm.+	Yellow brown (10 YR 5/6, dry); clay loam; massive to weak,medium subangular blocky; hard.

Orthic Gray Luvisol on Till

Drainage: well drained

Location: NE14-52-23-4

Horizon	Thickness	Description
L-H	4 cm.	Loose leaf litter.
Ae	15 cm.	Very pale brown (10 YR 7.3, dry); fine sandy loam; moderate fine platy; soft; abundant fine roots; clear, wavy boundary; 15-23 cm. thick.
AB	5 cm.	Grayish brown (10 YR 5/2, moist), coating of light brownish gray (10 YR 6/2); loam; strong medium subangular blocky; friable to firm; few fine roots; gradual, wavy boundary; 4-6.5 cm. thick.
Bt1	25 cm.	Dark brown (10 YR 4/3, moist); sandy clay loam; strong medium subangular blocky; firm; few medium and coarse roots; gradual, wavy boundary; 25-30 cm. thick.
Bt2	25 cm.	Dark brown (10 YR 4/3, moist); clay loam; moderate medium prismatic macrostructure; strong medium subangular blocky mesostructure; firm; very few medium and coarse roots; gradual, wavy boundary; 20-28 cm. thick.
Ck	23 cm.+	Gray (10 YR 5/1, moist); clay loam; massive.

Horizon		L-H	Ae	AB	Bt1	Bt2	Ck
CHEMICAL ANALYSES							
pH		6.4	5.7	5.5	6.0	6.9	7.2
$CaCO_3$ Equiv. (%)		- -	- -	- -	- -	- -	9.8
Total C (%)		- -	0.58	0.30	0.36	0.27	- -
Total N (%)		- -	0.05	0.02	0.04	0.03	0.02
Exchange	H^+	- -	0.91	0.99	1.18	0.65	- -
Analysis	Ca^{++}	- -	4.8	5.9	11.0	14.5	20.6
(meq/100g)	Mg^{++}	- -	1.2	1.8	3.8	4.9	3.8
	Na^+	- -	0.13	0.09	0.21	0.17	0.14
	K^+	- -	0.26	0.22	0.43	0.47	0.21
	TEC	- -	7.2	8.6	15.6	18.1	15.2
PHYSICAL ANALYSES							
Particle	S	- -	52	46	47	44	42
Size	Si	- -	39	33	23	24	28
Analysis (%)	C	- -	9	21	30	32	30
Texture		- -	SL	L	SCL	CL	CL
MINERALOGICAL ANALYSES							
Mont.			2		1		1
Illite			4		3		3
Kaolinite			4		4		4
Chlorite			5		5		5

Solodic Gray Luvisol on Till

Drainage: well drained

Location: SE18-52-22-4

Horizon	Thickness	Description
L-H	5 cm.	Loose leaf litter.
Ahe	4 cm.	Light brownish gray (10 YR 7/2, dry); loam; fine granular to weak platy; friable; abundant fine roots; clear,wavy boundary; 3-5 cm. thick.
Ae	16 cm.	Light gray (10 YR 7/1, dry); sandy loam; moderate coarse platy; soft; abundant fine roots; clear,wavy boundary; 14-19 cm. thick.
AB	12 cm.	Light yellowish brown (10 YR 6/4, dry) sandy clay loam; hard; weak prismatic macrostructure, moderate medium subangular blocky structure; hard; few fine roots; gradual,wavy boundary; 10-15 cm. thick.
Btnj1	19 cm.	Yellowish brown (10 YR 5/4, dry), ped surfaces dark brown (10 YR 4/3); clay loam; hard; weak prismatic macrostructure, strong medium subangular blocky mesostructure; very few fine roots; gradual, wavy boundary; 17-22 cm. thick.
Btnj2	17 cm.	Yellowish brown (10 YR 5/4, dry), ped surfaces dark brown (10 YR 4/3); clay loam; hard; moderate coarse prismatic macrostructure, strong medium subangular blocky mesostructure; very few fine roots; gradual, wavy boundary; 14-20 cm. thick.
Csk	14 cm.+	Brown (10 YR 5/3, dry); clay loam; massive to weak medium subangular blocky.

Rego Humic Gleysol on Alluvium

Drainage: poorly drained

Location: SE12-52-24-4

Horizon	Thickness	Description
Ah	12 cm.	Very dark brown (10 YR 2/2, moist); few common, distinct fine and medium mottles; sandy clay loam; weak granular; friable; abundant fine roots; clear, smooth boundary; 10-14 cm. thick.
ACg	22 cm.	Grayish brown (2.5 Y 5/2, moist), dark grayish brown (2.5 Y 4/2, moist); abundant, prominent, medium to coarse yellowish red (5 YR 4/8) and strong brown (7.5 YR 4/6) mottles; clay loam; weak coarse and medium blocky; friable, few fine roots; diffuse,wavy boundary; 19-25 cm. thick.
Cg	10 cm.+	Gray (10 YR 6/1, moist); sandy clay loam; massive.

Gleyed Black Chernozem on Lacustrine

Drainage: moderately well drained

Location: SW2-52-24-4

Horizon	Thickness	Description
Ah	18 cm.	Black (10 YR 2/1, moist); silt loam; weak fine subangular blocky; friable; abundant fine and very fine roots; clear, wavy boundary; 18-25 cm. thick.
Bm	28 cm.	Very dark grayish brown (10 YR 3/2, moist), dark brown (10 YR 3/3, moist); silty clay loam; weak fine subangular blocky; plentiful fine roots; gradual,wavy boundary.
BCg	10 cm.	Very dark grayish brown (10 YR 3/2, moist); silty clay loam; common, distinct, medium mottles; weak fine subangular blocky structure; few fine roots; clear,wavy boundary; 8-16 cm. thick.
Cskg	12 cm.+	Very dark gray (10 YR 3/1, moist), silty clay loam; massive; crystals of $CaSO_4$ present.

Orthic Black Chernozem on Glacial Outwash

Drainage: rapidly drained

Location: NE1-52-24-4

Horizon	Thickness	Description
Ah	15 cm.	Black (10 YR 2/1, moist); sandy loam; loose to weakly granular; friable; abundant fine roots; clear,wavy boundary; 12-30 cm. thick.
AB	16 cm.	Very pale brown (10 YR 7/3, dry); sandy loam; loose single grain; loose; plentiful fine roots; clear,wavy boundary; 12-18 cm. thick.
IIB	45 cm.	Dark yellowish brown (10 YR 4/4, dry); coarse sandy clay loam; weak prismatic, moderate medium blocky; few roots; clear, wavy boundary; 35-45 cm. thick.
IIC	30 cm.+	Gravel.

Dark Gray Luvisol on Glacial Outwash Overlying Till

Drainage: moderately drained

Location: NW3-52-23-4

Horizon	Thickness	Description
L-H	3 cm.	Loose leaf litter.
Ah	9 cm.	Dark gray (10 YR 4/1, dry); sandy loam; weak fine granular; soft; abundant fine roots; clear, wavy boundary; 8-11 cm. thick.
Ae	10 cm.	Pale brown (10 YR 6/3, dry); loamy sand to sand; single grain; loose; plentiful fine roots; clear, wavy boundary; 8-13 cm. thick.
Bt	33 cm.	Pale brown (10 YR 6/3, dry); sandy loam; weak prismatic; soft; few fine roots; clear, wavy boundary; 30-37 cm.
IICk	35 cm.+	Yellowish brown (10 YR 5/6, dry); sandy clay loam; massive to weak blocky structures.

APPENDIX A-II

Correlation of soils mapped in this project to soil series mapped in the Edmonton sheet by Bowser _et al_. (1962).

Order	Soils Mapped in this Project	Soils Mapped in the Edmonton sheet (Bowser et al. 1962)
Chernozemic	Orthic Black Chernozem on lacustrine	Navarre
	Orthic Black Chernozem on glacial outwash	Ferintosh
	Orthic Black Chernozem on till	Beaverhill
	Eluviated Black Chernozem on lacustrine	Malmo
	Eluviated Black Chernozem on till	Angus Ridge
	Orthic Dark Gray Chernozem on lacustrine	Mico
	Orthic Dark Gray Chernozem on till	Falun
Solonetzic	Black Solonetz on lacustrine	Wetaskiwin
	Black Solod on lacustrine	
	Black Solod on till	
Luvisolic	Orthic Gray Luvisol on till	Cooking Lake
	Orthic Gray Luvisol on lacustrine	Maywood
	Dark Gray Luvisol on till	Uncas
	Dark Gray Luvisol on lacustrine	Macola
Gleysolic	Saline Humic Gleysol on lacustrine	Navarre Meadow

SOIL MAP OF CENTRAL STRATHCONA COUNTY, ALBERTA

LEGEND

Order	Great Group	Soil	Parent Material	Symbol
Chernozemic	Black	Eluviated Black	Lacustrine	1
		Eluviated Black	Till	2
		Orthic Black	Lacustrine	3
		Orthic Black	Till	4
		Orthic Black	Glacial Outwash	5
		Gleyed Black	Lacustrine	6
		Gleyed Black	Till	7
		(Gleyed) Eluviated Black	Till	8
		Solonetzic Black	Lacustrine	9
		Solonetzic Black	Till	10
		Solodic Black	Lacustrine	11
		Solodic Black	Till	12
		(Gleyed) Solonetzic Black	Lacustrine	13
		(Gleyed) Solodic Black	Till	14
		Orthic Dark Gray	Lacustrine	15
		Orthic Dark Gray	Till	16
		(Gleyed) Dark Gray	Lacustrine	17
Solonetzic	Solod	Black Solod	Till	18
		Black Solod	Lacustrine	19
		Gleyed Solod	Till	20
		Gleyed Solod	Lacustrine	21
	Solonetz	Black Solonetz	Lacustrine	22
		Black Solonetz	Till	23
		Gray Solonetz	Lacustrine	24
		Gray Solonetz	Till	25
		Gleyed Solonetz	Lacustrine	26
		Gleyed Solonetz	Till	27
Gleysolic	Humic Gleysol	Orthic Humic Gleysol	Glacial Outwash	28
		Orthic Humic Gleysol	Lacustrine	29
		Orthic Humic Gleysol	Till	30
		Orthic Humic Gleysol (peaty phase)	Till	31
		Orthic Humic Gleysol (peaty phase)	Lacustrine	32
		Saline Humic Gleysol	Lacustrine	33
		Rego Humic Gleysol	Lacustrine	34
	Gleysol	Saline Gleysol	Lacustrine	35
		Rego Gleysol	Glacial Outwash	36
	Eluviated Gleysol	Humic Eluviated Gleysol	Lacustrine	37
		Humic Eluviated Gleysol	Till	38
		Fera Eluviated Gleysol	Till	39
Luvisolic	Gray Luvisol	Dark Gray Luvisol	Lacustrine	40
		Dark Gray Luvisol	Till	41
		Dark Gray Luvisol	Glacial Outwash	42
		Gleyed Dark Gray Luvisol	Till	43
		Orthic Gray Luvisol	Lacustrine	44
		Orthic Gray Luvisol	Till	45
		Orthic Gray Luvisol	Glacial Outwash	46
		Gleyed Gray Luvisol	Till	47
		Solodic Gray Luvisol	Till	48
		Solodic Gray Luvisol	Lacustrine	49
Organic	Humisol	Terric Humisol		50
	Mesisol	Terric Mesisol		51
Soil Complex	Rego Gleysol - Terric Humisol Complex			52
Miscellaneous land unit		Disturbed Land		DLD

Map Unit Key — Soil Texture - Topography

a - b

Example: 1c-b: Eluviated Black Chernozem on lacustrine; silt loam; 0.5 - 2% slopes.

Textural Classes:

a - loam
b - clay loam
c - silt loam
d - sandy loam
e - loamy sand
f - fine sandy loam

Topography:

slope	complex topography	simple topography
0-0.5%	a	A
0.5-2%	b	B
2-5%	c	C
5-9%	d	D
9-15%	e	E

Permanent Lake - W

Wet Spot - *

Scale: 4 inches equals 1 mile

N

SOIL MAP OF CENTRAL STRATHCONA COUNTY, ALBERTA